Dental Digest

April 1955

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CANCER

STRIKES

1 OUT OF 4

STRIKE BACK

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APRIL 1955

About Our CONTRIBUTORS

HARRY L. PAGE, who attended Hotchkiss and Yale, has published a book on the subject of mucostatics and many original articles on numerous aspects of prosthetics in which he is an authority. His present article is THE CRANIAL PLANE.

R. K. UNDERMAN, D.D.S. (Ohio State University, College of Dentistry, 1938) is a general practitioner. Doctor Underman has published a number of practical articles on mechanical subjects. His presentation in the current issue describes a home workshop project, EFFICIENT PORTABLE UTILITY CABINET.

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HAROLD K. BOX, D.D.S. (University of Toronto, 1914), Ph.D. (University of Toronto, 1920), one of the world's authorities on the subject of periodontics, has published sixty articles including studies in periodontal pathology, treatment of the periodontal pocket, and necrotic gingivitis, and a book, TWELVE PERIODONTAL STUDIES. Another book, OXYGEN INSUFFLATION IN PERIODONTAL DISEASE, Charles C Thomas, is now in press. Doctor Box is an Honorary Member of the American Academy of Periodontology, Honorary Member of the American Academy of Dental Medicine, Honorary Life Member of the Ontario Dental Association, Honorary Life Member of the Academy of Dentistry, Toronto. He is at present Research Professor of Periodontology at the University of Toronto. In his current article he expresses his point of view concerning fluoridation of public water supplies.

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The CRANIAL PLANE

HARRY L. PAGE, Valparaiso, Indiana

DIGEST

The contention that no articulator can be made that will reproduce exact jaw movements is no longer tenable. To duplicate any kind of action, however, the imitating action must move with reference to fixed planes having relationships identical to the relationships possessed by the original action. The importance of this principle in reproducing jaw function in an articulator, the method used, and the gratifying results are the substance of this article.

Plane of Reference a Necessity

It is not difficult to understand why the gain made by a fullback who has run 25 yards without crossing the scrimmage line is *zero*. It is not necessary to explain that all ball movement is evaluated solely by its relationship to a plane represented by the goal line. Everyone comprehends that it is the angle at which the run approaches or leaves this goal line that is significant. Without lines paralleling the goal line as references to this plane, it is impossible to determine the all-important angle which spells gain, no gain, or loss.

Result of Removal of Reference Line—Suppose we remove all lines from the playing field, do away with the stands and let the field itself lie in the middle of a vast prairie. With no yardage or goal lines for references, how long would it be until judgment of gains or losses would be impossible? Even though the teams lined up properly for the first play after kick-off, it would take no more than one or two additional plays to find them lined up at an angle away from the proper direction. In a short time, chaos would exist and the game would become a farce. A ball carrier, in shaking off a series of tacklers might run two hundred yards (there would be no way to tell how far he *should* run) parallel to or even away from the goal line he is supposed to cross.

Transference of Movements Impossible—Any dentist who is a football fan would deride a football game played under such conditions. It is no more ineffectual, however, than the almost universal attempt to articulate teeth without first establishing a reference plane in the head that can be and has been transferred intact to the articulator. Without such a reference plane, the natural deviations of functional jaw movements from the sagittal plane cannot be repeated accurately in the articulator. They will have no more useful relation to off-sagittal plane function than the plays made on the unmarked football field have to a real goal line.

Example—Adjustable articulators have angulation readings on the condyle races. A recent article declared that settings of 30° at the condyles and at the incisal guide plate would produce lower buccal cusp inclines of 30° on the nonworking or "balancing" side and 15° on the working side. The reader was given to understand that such a procedure would result in a similar situation when the teeth were installed in the patient's mouth. Nothing could be further from the truth.

Angle Must Have Two Sides—The immediate question is, "30 and 15° to what?" There must be an adjacent or reference side to an angle before we can talk of degrees. Since no reference plane was established in the head and brought over to the articulator in the example being cited, it is clear that the reference plane must be the lower frame of the articulator in which the case has been mounted. With the articulator seated on the bench, the reference plane becomes the horizontal. What has this to do with the head? The answer is, "Exactly nothing."

Worthless Situation—Suppose such a case is so articulated and installed in the patient's mouth. Suppose further that the angle of the condyle paths with the head held normally actually *is* 30° off horizontal. Assume, also, that these condyle paths do have a value in articulation even though the contrary has long since been demonstrated.[1,2,3,4] The angle of the condyle paths off horizontal would still have no importance. Instead, it would be the degree of angulation between the condyle paths and the occlusal plane that would count. The latter generally shows a marked declination off horizontal in the sagittal plane. Assuming a 20° declination of the occlusal plane with the head held normally and we have a 20° error in cutting the cuspal inclines. How fortunate it is that the condyle

[1]Kurth, L. E.: Mandibular Movements in Mastication, JADA **29**:1769-1790 (Oct.) 1942.
[2]Craddock, F. W.: The Accuracy and Practical Value of Records of Condyle Path Inclination, JADA **38**:697-710 (June) 1949.
[3]Jankelson, Bernard; Hoffman, George J.; and Hendron, J. A.: The Physiology of the Stomatognathic System, JADA **46**:375-386 (April) 1953.
[4]Page, Harry L.: Temporomandibular Joint Physiology and Jaw Synergy, DENTAL DIGEST **60**: 54-59 (Feb.) 1954.

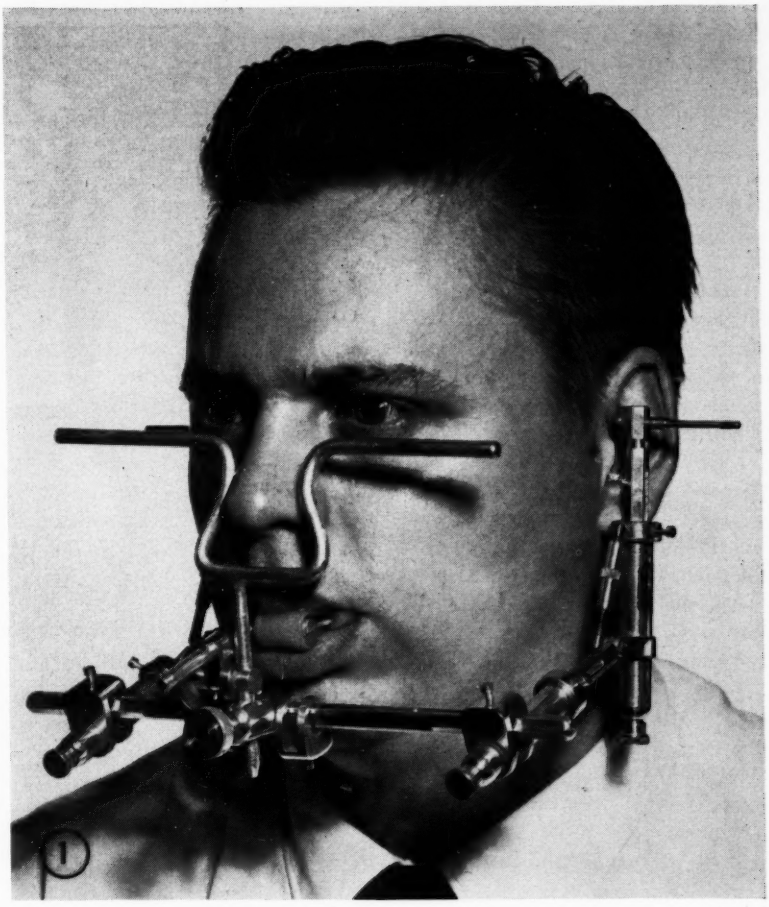
path inclination is *not* an important factor in the articulation of teeth! Otherwise the millions of cases that have been built to such erroneous condyle path records would have been vicious destroyers of jaw tissues.

Utilization of Occlusal Plane—There is only one way to transfer and utilize an occlusal plane correctly. It cannot be done by relating edentulous occlusion rims or the casts of natural teeth to some indicator on the incisal guide pin of an articulator. It must be done by establishing a reference plane in the head and repeating this plane exactly in the instrument. Then articulator movements that deviate from pure sagittal plane opening or closing will be mathematical duplicates of the same movements when made by the patient's jaw. The value of such duplication is obvious.

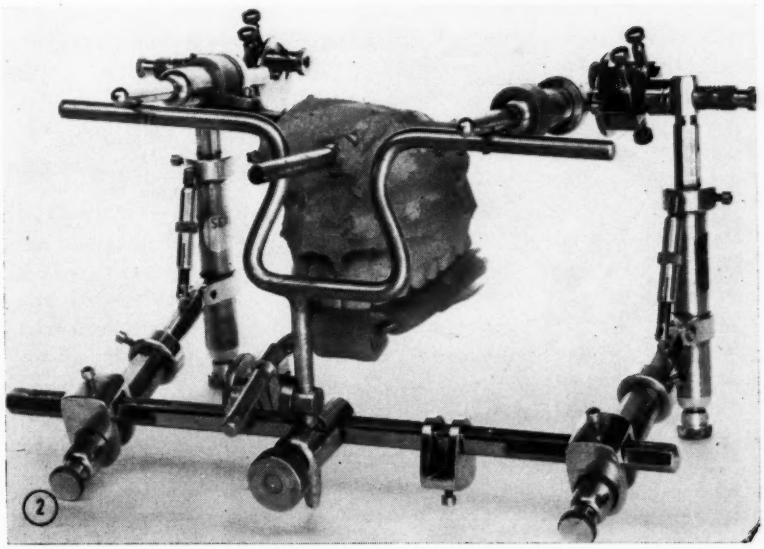
False Impression Created—A cranial reference plane is not new in dental articulation concepts. Simon, Wadsworth, McCollum and others continually and wisely, albeit vainly, advocated the use of such planes. Unfortunately, all of these planes were and are designated as running from and to some specific anatomic landmarks. This inadvertently created the false impression that the location and use of these particular anatomic origins and terminals were vital to success. Furthermore, the assumption was fostered that any subsequent operations must be oriented exactly to the same anatomic markings or failure would result. A little thought shows how untrue this is.

Individual Cranial Plane Sufficient

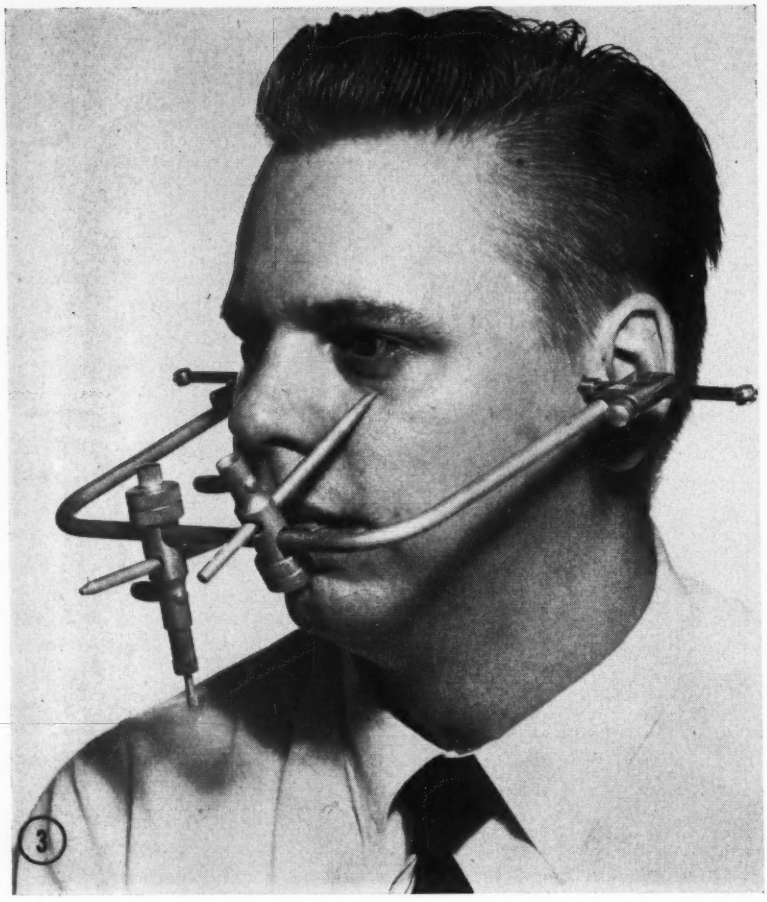
In the absence of prior markings it would be impossible to establish exactly the same plane twice, yet either plane would suffice. One might know, for instance, where to locate the approximate low point on an infraorbital arch but to return to the exact but unmarked point used in a previous operation would be a miracle; nor is it critical. It is important only that the plane established in the individual operation be repeated in the articulator. Two or two hundred



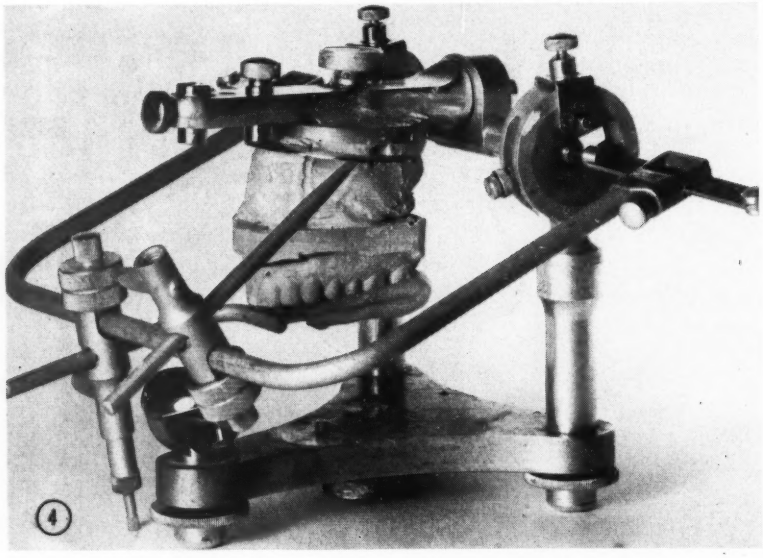
1. ***Cranial plane established by head relator.***



2. ***Cranial plane duplicated in the Transograph.***



3. ***Conventional method of establishing cranial plane.***



4. ***Conventional duplication of cranial plane in the articulator.***

such will produce identical static and kinematic relationships.

Definition—The articulation method known as Transographics uses any convenient plane individual to the patient and individual to the operation on that patient. It is called a "cranial plane" and is defined as "The relationship of any convenient cranial reference point to the hinge-axes."

Method of Locating Reference Point—Not because it has any especial significance but only because it produces a convenient amount of opening between the upper and lower frames of the Transograph, the reference point is located by setting the horizontal bars of the head relator (Fig. 1) approximately level with and parallel to the pupils of the eyes. If the patient has a long head (as in Figure 1) the relator bars are lined up below the pupils; if a short head, the bars are placed above the pupils. It is not important that this be done with mathematical exactitude.

Method Used in Transfer—What is important is that the same cranial plane shall be transferred to the articulator. How this transfer is made accurately in the Transograph will be seen by studying Figure 2.

Effects of Contributing Factors—There have been and still are many who doubt the value of the cranial plane. These objectors report that they have tried studiously to establish and use such a plane yet the results obtained were not one whit better than those produced by ordinary methods or even by the well-known and ineffectual "barn door hinge." Such an admission is indicative of inadequate training and thinking. The possible effect of contributory factors is overlooked and failure is blamed on the cranial plane alone. This arbitrary attitude is all too common.

Results of Arbitrary Decisions—When sore mouths appeared under mucostatic denture bases, mucostatics was held to be the sole culprit. No consideration was given to the well-known fact that malarticulation alone creates soreness under a well-fitting denture base. Objectors to the cran-

ial plane should realize also that it is mathematically impossible to duplicate jaw movements accurately in an articulator without *some* form of reference plane thus making it clear that failure *must* have been caused by other factors.

Major Errors in Conventional Articulation

There are three major errors in conventional articulation that act to nullify the value of a cranial plane:

1. *Conventional Method of Establishing the Plane*—Figure 3 shows a typical cranial plane in common use. The origin of motion and rotational control center of the condyle has been located arbitrarily at 13 millimeters anterior to the tip of the tragus on a line to the corner of the eye. The anterior apex of the plane is located by the indicator at the low point on the infraorbital arch. Relying on this cranial plane, the operator has scrupulously duplicated it in the articulator (Fig. 4).

Projection of Axal Center: High on the anterior rim of the ear (Figs. 3 and 1) will be seen a small black dot. This is the projection of the true axal center of the condyle as determined accurately by a hinge bow.

Terminals of Motion Distant from True Rotational Centers: In this instance the value of the cranial plane will be destroyed by the transfer to the articulator of rotational centers, centers that are also origins and terminals of translational motion, that are a gross 20 millimeters away from the true rotational centers of the condyles.

Discrepancy Source of Disaster: Despite arguments to the contrary, such a discrepancy is the rule rather than the exception. Nor must it be overlooked that an error much less than one third the error shown here will be equally as disastrous.[5] It is not then, a failure of the cranial plane that will upset the result in this case; it is a failure to use accurate rotational control centers (hinge-axes).

2. *Centric Relation*—A cranial plane is set up for the purpose of orienting jaw *motion* in the articulator. Kinematic orientation is essential because articulation deals with function and *function is motion.* Within the range of interdentation especially, it is vital that movements in the articulator be oriented to follow the same paths as those followed by the patient's jaw. Centric relation permits no such functional orientation.

A Fixed Position: Centric relation is a static position, good at just one point of jaw apposition. Closing or opening movements from the vertical dimension at which the centric relation bite was taken will follow entirely different paths in the head from the paths dictated by the hinges of the articulator in which the case, whether it be dentulous or edentulous, must be prepared for the mouth.[5]

Cause of failure: Again, cranial plane value is destroyed by an outside error.

3. *Lateral Motions*—It has been adequately demonstrated that lateral motions are not only without value[1,2,3] but that they are also seriously detrimental.[6] Once more, failure charged to the cranial plane is really due to another cause. It is time to discard these voluntary and artificial movements in favor of natural and involuntary functional movements. It has long since been shown that these can be captured and utilized by a properly conceived and constructed articulator.[7]

Relationships Constant in Suitable Articulator

Once a cranial plane has been established in the head and oriented to the maxilla, it is impossible to mount the upper cast incorrectly in a properly designed articulator. This is due to the fact that the projections of the rotational centers of each condyle, centers which also constitute the posterior apexes of the cranial plane are located on the immobile skin. The relationships of these points, therefore, to the third or anterior and likewise immobile apex of the cranial plane cannot change regardless of mandibular or condylar movements. Nor can the relationship of any of these three apexes of the cranial plane to any three theoretic out-of-line points that are the physical requirement in orienting any body, such as the upper alveolus, be changed.

Relationship Transferred Intact—The entire cranium and the maxilla now have a relationship that can be carried over intact to a suitable articulator, thus making the relationship of the latter identical with the relationship in the head.

Method of Transference—To accomplish this it is only necessary to have the patient close upon and hold a wax or some similar bite on a bite fork that is attached to a head relator and to a hinge bow that is, in turn, adjusted to the patient's hinge-axes (Fig. 1).

Consummation of Entire Functional Head Relationship—It is quite possible that the mounting bite given by the patient may not be correct. This will have no effect on the accuracy of the maxilla to hinge-axes relationship. Because of the cranial plane, the upper will always be oriented and mounted correctly. To consummate the entire functional head relationship, it is then only necessary to see that the lower is related kinematically to the upper.

Lower Related to Upper: This is done by taking wax bites of thicknesses varying from two to 10 or more millimeters with at least one thick bite into which the patient has sunk his teeth deeply. When an articulator mounting will accept perfectly all of these bites of varying thicknesses and depths, there is no question but that the mounting has accurately duplicated the patient's functional origins, terminals, and controls (hinge-axes); his cranial plane and his upper to lower alveolar relationships.

Constant Vertical Dimension Unnecessary: When these relationships are not accurately duplicated, it is merely necessary to remount the lower to bites that *can* be proved to be correct. Within the limits of es-

[5]Page, Harry L.: Lexicography, Hinge Opening, Hinge Closing, and Centric, DENTAL DIGEST (in press).

[6]Page, Harry L.: An Appraisal of Balance, DENTAL DIGEST **60**:200-204 (May) 1954.

[7]Albinson, Reuben N.: Transographic Articulation. Paper read before the Chicago Dental Society Annual Meeting, February, 1952.

thetics and muscle tolerance, occlusals may now be opened or closed at will on the instrument without disrupting in the slightest the final *mouth* articulation, for all sagittal plane movements in final functional closure have been proved to be operating on a constant radius. Exact maintenance of vertical dimension is no longer necessary.

Use of Individual Head as Articulator Impractical

It is a frequent assertion that the only true articulator is the individual head, itself. This is too obvious to warrant discussion. Numerous clinicians and operators refuse to use conventional articulators on the grounds that the latter do not duplicate jaw movements or even simple occlusal relationships. In a commendable effort toward accuracy they attempt to use the patient's head as the articulator. Theoretically, this is ideal but its efficacy as a procedure is open to serious question.

Difficulties Present—(1) It would be highly impractical to set up artificial teeth on occlusion rims inside the mouth.

(2) It would be equally impractical to rotate or otherwise bring them into proper apposition in the mouth after they had been set as accurately as possible outside the head.

(3) The carving in the mouth of wax occlusals with cusps properly interdentated for the dentulous in an occluso-rehabilitation case would present insurmountable difficulties. The same would apply to the paralleling of precision attachments.

(4) It has already been noted that the patient's lateral jaw motions cannot be used for they are detrimental to articulation.[6]

Functional Duplication Required—With the exception of grinding to remove simple closure interferences, any semblance to *complete articulation must be done on some form of articulator*. Unless this instrument is exactly representative of jaw *function*, the articulator results must then be corrected by trial and error in the mouth after insertion. Such is the current method universally employed but equally universal experience is conclusive evidence that this is not only tedious but, also, most unsatisfactory.

Mathematical Solution to Problem

Whenever mathematics is mentioned as the solution to the articulation problem it provokes numerous objections. The inference is quite plain; namely, a belief that mathematics cannot be successfully applied to articulation. The objectors point out that the very instruments they claim to find untrustworthy come from a background of highly plausible geometric drawings and trigonometric calculations. This is not denied. But if the articulation problem is to be solved at all, it *must still be solved by mathematics*. The only possible way to articulate teeth correctly is by producing an articulator that can be so adjusted as to be the exact mathematical counterpart of the individual jaw *in function*.

Physiologic Concepts at Fault—To create an articulator that *is* to duplicate jaw function, the obvious beginning must be an understanding of jaw function itself. It is here that error has consistently defeated the most careful and skillful efforts. It has not been the articulators but the physiologic concepts taught to the profession and offered to the manufacturers as bases for those articulators that are at fault. *True jaw function has been entirely disregarded in college and clinical teaching while worthless and detrimental nonfunctional jaw movements have prevailed*. Naturally, an articulator built for and adjusted to nonfunctional movements can produce only nonfunctioning results.

Functional Jaw Movements Described—When a human being chews he does not wag his jaw from side to side like a dog's tail. He opens his mouth generously to introduce the food, moves his open jaw to one side or the other to locate the bolus, sets it for chewing and then *closes on an arc that moves upward, inward, and forward*.

Radial Lateral Movements not Involved—No radial lateral movements (the outward and protrusive movements universally used by conventional articulation) are involved. Nor will an envelope of motion based upon radial lateral movements be corrected for these are the same laterals that have been proved to be outside functional range[1] and destructive to occlusion.[6]

Combination of Closing Movements Important—The first two movements are part of functional *opening* and consequently are interesting from an academic status only. Hence they may be disregarded for our present purpose. It is the last or combined vertical, medial, and protrusive movements that are important for it is this combination that eventually interdentates the teeth. Teeth and cuspal inclines must be so apposed that they will travel this *closing arc* to partial or complete functional interdentation without interference which means absence of all preocclusal or so-called "balancing" contacts.

Procedure for Duplicating Functional Closure

1. *The Hinge-axes*—In the last few millimeters of functional closure the working condyle is anchored against the anterior slope of the mandibular fossa. In this anchorage it pivots against its fossal bearing and at the same time revolves upon its own rotational control center, or hinge-axis. By locating and transferring both condylar hinge-axes to a suitable articulator, the latter is able to duplicate this final closure on either side in so far as it relates to the sagittal plane. It is not expected, however, that any jaw can close on an arc that lies wholly within *one* sagittal plane so this is not enough.

2. *The Bennett Movement*—Natural asymmetries of the condyles and fossae in shape, size, and head position will interject small collateral bodily shifts of the jaw known as the Bennett movement. While it is quite possible to reproduce these, it is much simpler and just as effective to work with their equivalents in the articulator. This is done by discarding the single rigid axle of the conven-

tional articulator with its point centers of rotation in favor of an individual axis for each condyle with individual *axal* centers of rotation.

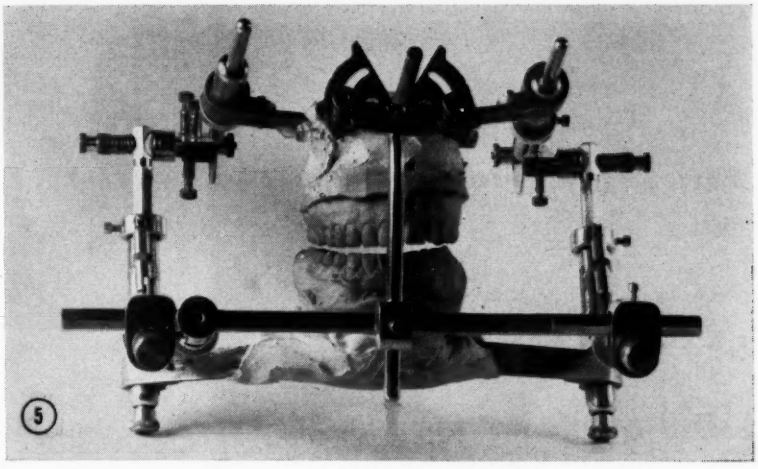
Mechanical Equivalent of Bennett Movement: Having the same relative asymmetry as the head hinge-axes, these axal centers produce a torque in the articulator which is the mechanical equivalent of the true Bennett at all degrees of opening.

Duplication Impossible Without Cranial Plane: Let it be noted that, as small as this Bennett movement usually is, it cannot be duplicated accurately in any articulator without a cranial plane, for it is an off-sagittal plane movement and to omit an accurate Bennett would be disastrous. While the Bennett movement is too small to be shown here by photograph, the operation of its mechanical equivalent may be studied by consulting a previous article.[8]

3. *Functional Closing Movement*—There remains still one more functional movement that must be incorporated in the articulator; namely, the off-sagittal plane angle at which final closure occurs in the transverse plane. Here, too, what is happening with the patient's mouth open generously is of little concern. It is only the last few millimeters of closure that are important.

Angle of Final Closure Demonstrated—Experimentation as well as comparison with the results published by Boswell,[9] and others, make it clear that the angle of final closure between the cranial and transverse planes along which the human jaw chews civilized food lies between 50° plus and 70° minus.

Final Stroke Reproduced—By the use of a jaw movement guide (Fig. 5) with cams adjustable to any required angle for guidance of the cam follower (the center rod attached to the upper frame of the Transograph), jaw movement along this final chewing angle can be duplicated simultaneously with the sagittal closing and the Bennett. Thus, the patient's final masticating closure stroke is reproduced faithfully.



5. ***Transograph duplicating functional closure. Right side chewing.***

Closure Reproduced in Absence of Food—It is hardly necessary to discuss the fact that the Transograph also duplicates functional jaw closure when no food is present. The only change is in the angle of closure in the transverse plane. This being actually or nearly 90° off the cranial plane, it is much steeper than the chewing angle to which the cuspal inclines have been adapted. Hence, closure takes place under the control of the hinge-axes and the Bennett movement both of which are already incorporated in the Transograph as described previously and, since the cuspal inclines are cut to accomodate a chewing angle that is flatter, no cuspal interference or preocclusal contact will be experienced.

Comparative Results

1. Conventional articulation succeeds only when the operator is able and willing to make time-consuming, trial-and-error mouth adjustments after the case has been approximated by the articulator. Too often a satisfactory consummation never is attained and no matter what may be the degree of apparent success, teeth rarely finish with anything resembling efficient cusps.

2. When an articular reproduces *true functional jaw movements*, the results are entirely different. This applies to all types of cases from single unit bridges to full mouth reconstruction; from partials to full dentures.

3. In orthodontia such an articulator is an invaluable aid in diagnosing, checking, and as a precise indicator of any supplementary occlusal grinding.

4. In all types of cases teeth and cusps being apposed and adapted to natural masticating movements will be placed and formed naturally for the patient and will be highly efficient. In the absence of joint or mouth disease or of failure of materials, no postoperative adjustments are necessary. *Cases are finished when installed.*

Summary

It has been shown that no jaw movements except pure opening and closing, can be duplicated by an articulator unless the upper frame is oriented to some cranial plane taken from the head. This plane has been explained while comparisons with and without it have been discussed.

Failure in articulation has been found to originate in disregard of jaw function and reliance upon artificial nonfunctional movements. The nature of the true functional movements of the jaw, how they may be captured, and how they may be utilized with mathematical precision has been described.

104 *Garfield Avenue.*

[8]Page, Harry L.: The Bennett Movement, DENTAL DIGEST **57**:412-414 (Sept.) 1951.

[9]Boswell, J. V.: Practical Occlusion in Relation to Complete Dentures. J. Pros. Dent. **1**:309 (May) 1951.

Efficient Portable UTILITY CABINET

R. K. UNDERMAN, D.D.S., Akron, Ohio

DIGEST

The cabinet described in this article is a simple home workshop project. It was inspired by the difficulty experienced by the author's dental assistant in moving the three portable units into position for use. Facility of operation is provided because of the ready availability of the units in the cabinet.

Equipment on Three Shelves

Top Shelf—On this shelf is the Thompson hydrocolloid conditioner used for boiling, storing boiled hydrocolloid, and tempering or conditioning the loaded trays.

Use as Compound Heater: To use this unit for its original purpose and at the same time use it as a compound heater, plastic drinking glasses are obtained of the type that can be squeezed or folded without breaking. Modeling compound is placed in these containers and they are placed in the vat having a suitable temperature.

Trays Filled: The compound is softened without smearing the inside of the vat. The plastic squeezable "glass" is collapsed to express enough compound to fill larger trays. Smaller pellets for loading copper tubes are placed in different cups as needed.

Center Shelf—A Gomco portable aspirator, used (1) as an aid to vision in surgery, (2) to clean away amalgam particles in mouths where local anesthetic makes it difficult for the patient to wash these particles from the mouth, and (3) to remove water from the vats of the hydrocolloid unit when cleaning it, occupies the center shelf.

Occasionally, when the saliva ejector of the unit becomes clogged while in use, the surgical handle is removed and the saliva ejector is attached to the Gomco for the time that the assistant requires to repair the clogged saliva ejector on the unit. Handle clips purchased at a hardware store hold the suction tip handle at a convenient position.

Bottom Shelf — Coles Radiosurg RD1, is on the lower shelf. The clips for both the electronic scalpel and the cautery have been unscrewed from the side of the radiosurg and attached just inside the upper left wall of the cabinet where they are more conveniently reached.

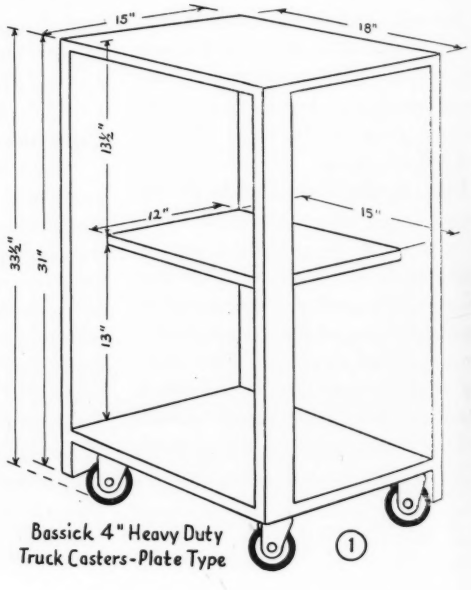
Aluminum Pockets Visible: The indifferent plate with its conductive cord slips into the aluminum pocket beneath the bottom shelf. The foot control slips into the larger aluminum pocket. Both of these pockets are visible in the view of the bottom of the cabinet.

Use of Radiosurg: The unit is used in removing tissue, when necessary, for the hydrocolloid technique.

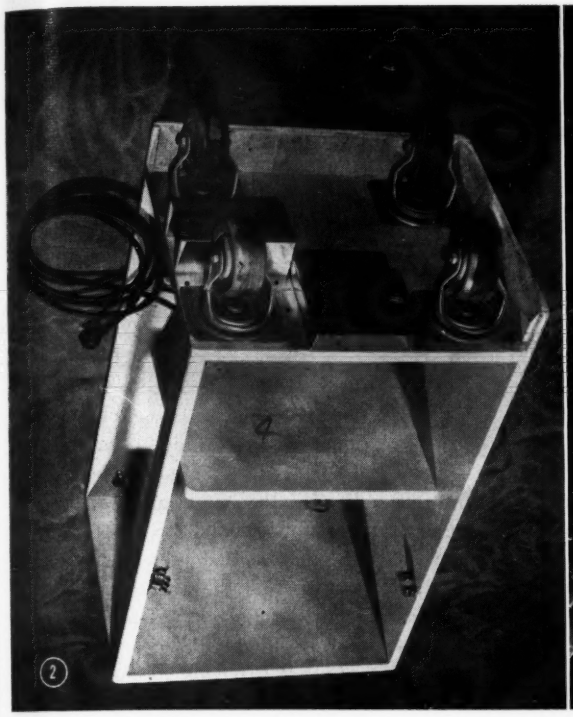
Comment

Combining these three portable units in one cabinet, makes them more convenient to use, makes them more readily available for instant use. Wiring the cabinet itself with three convenience outlets, only one extension cord, instead of three, is required. The idea can be adapted to serve any combination of portable equipment desired, and is not limited only to just these three items described.

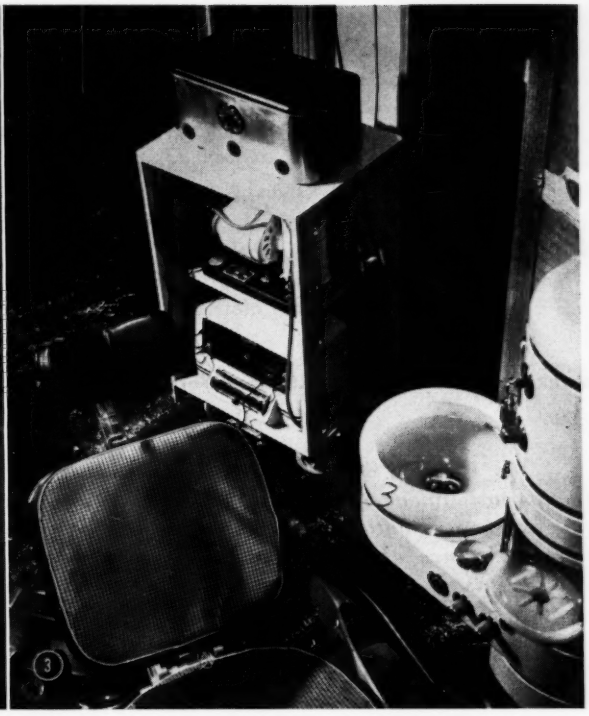
2108 *First National Tower Building.*



1. ***Drawing showing dimensions of a cabinet that is practical for these three pieces of equipment. Different equipment may call for variations in these dimensions.***



2. *Bottom view of cabinet, showing the aluminum pockets for the indifferent plate and the foot control of the Radiosurg. The heavy duty 4-inch ball-bearing truck castors permit easy and silent movement of this cabinet.*



3. *Shows approximate position of cabinet when in use at the chair. Contents are not in the patient's view, and the cabinet can be reached by operator and assistant with equal ease.*

4. *Shows working sides of the portable cabinet holding the hydrocolloid unit, the surgical aspirator, and the electronic scalpel-cautery unit. No doors to get in the way.*

5. *Shows cabinet in storage position, turned toward the wall and out of use. Keeps equipment from view of patients as they enter and leave.*

Approach to MOUTH RECONSTRUCTION—

Part Four

MURRAY N. RUBINSTEIN, D.D.S., New York

DIGEST

In this installment of a series of five articles the author discusses the importance of incisal guidance as it is related to the design of the posterior patterns, and continues his outline of procedural steps in mouth reconstruction. A method for establishing the occlusal plane and step-by-step directions are given for the completion of splints to be used as an aid in biologic function.

Incisal Guidance

An important consideration in arriving at the occlusal contour form to be decided on in reconstruction, and inherent in this development is the all-important factor, incisal guidance, as it relates to the design of the posterior patterns.

Control of Mandibular Movements—The direction of movement of the mandible as the teeth come to contact is controlled by (1) the contour of the tooth surfaces, and (2) the guiding factors within the temporomandibular joint. Schuyler[24] lists the following as the three main factors of occlusion:

(a) Incisal guidance
(b) Anterior articulating incline of the glenoid fossae
(c) The lateral incline of the glenoid fossae or Bennett movement

Dominant Influence on Posterior Tooth Function—Of the three main factors, the incisal guidance which in the normal occlusion is the lingual contour of the upper anterior teeth, is listed as of first importance. The contention is that (1) because of its inflexibility as compared to condylar movement, and (2) because of its proximity to the posterior teeth, incisal guidance has a dominating influence on posterior tooth function.

Favorable Distribution of Stress—It is accepted that the most favorable distribution of stress is one where anterior teeth and posterior teeth can achieve equalized functional contact in both centric and eccentric maxillomandibular relations. A favorable incisal guidance is therefore of the utmost importance.

Deteriorating Effect Created—A steep incisal guidance will require steep posterior inclines to obtain functional contact on the posterior teeth. It has been determined that steep inclined interdigitating cusps require greater horizontal stresses to accomplish mastication thereby creating a deteriorating effect on the supporting bone and tissues.[25] This process is shown in Figure 23.

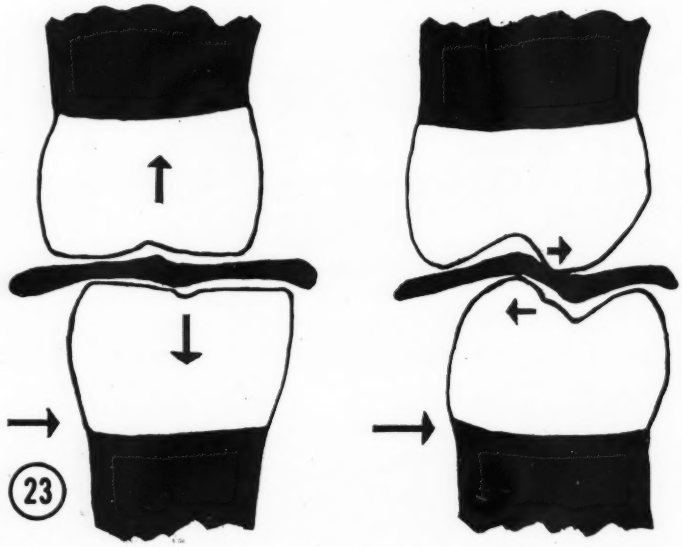
Cuspal Direction of Force—Cusps tend to introduce a horizontal component while the absence of cusps tend to translate the direction of force axially.[19]

Advantage of Axial Load—The obvious advantage of placing the load axially is that the periodontal fibers and bone surrounding the root absorb

[24]Schuyler, C. H.: Factors of Occlusion Applicable to Restorative Dentistry, J. Pros. Dent. **3**:772 (Nov.) 1953.

[25]Myerson, S.: Occlusal Forms and Nature's Plan, DENTAL DIGEST **59**:65 (Feb.) 1953.

[19]Moses, C. H.: Natural Laws in Dentistry, J. Pros. Dent. **3**:307 (May) 1953.



23. ***Cusps tend to introduce a horizontal component while the absence of cusps tend to translate the direction of force axially. (Courtesy of C. H. Moses, Natural Laws in Dentistry, J. Pros. Dent. 3:307, May, 1953.)***

the stresses equally from the entire root surface, the relatively small apical area receiving pressure within the limits of tissue tolerance.

Reduction of Incisal Guidance Advisable—It follows that to reduce (1) the possibility of physiologic impairment of the alveolar support, and (2) involvement of the condyles in the fossae due to restricted movement created by steep cusps, reduction of steep incisal guidances is advisable.

Method to Attain Reduction—Modification of a steep incisal guidance may be attained (1) by slight increase of the posteriors, (2) by reduction in length of the anterior lowers, and (3) by shortening of the length of the upper anteriors (within the limits of esthetics).

Undesirable Stresses Reduced—Reduction of the inclination of incisal guidance as much as the case will allow will result in offsetting undesirable lateral stresses upon the teeth and their supporting structures which could derive from steep inclines on the posterior teeth.

Establishment of Incisal Guidance—The desired incisal guidance may be established from vertical dimension, centric relation, and favorable changes of the anterior teeth to comply with esthetic requirements. The incisal guidance then controls the required inclination of the cusps of the posterior teeth.

Technical Procedures

In this technique the Hanau articulator is suggested because of the anterior guide pin. The casts are mounted in centric using the facebow. From the protrusive record the condylar guidance is established. The lateral posts may be set by formula but this is of questionable value. Kurth[23] has stated as a conclusion from careful tests that no demonstrable difference was noted when the lateral posts were set from 0 degrees to 20 degrees. It is his conclusion that "the Bennett movement represented by the lateral posts adjustment has no practical significance and absolutely no scientific purpose" and should not even be incorporated in articulator construction.

Procedures

In the Seides method of creating cuspal inclination the following steps are taken:

1. The mounted models are tinfoiled.
2. If the teeth have been considerably worn down reconstruction will be divided between the upper and lower teeth.
3. Bite-rims are waxed with the aid of a 20° template to balance much in the same manner as those for an edentulous case.
4. Cusp points which protrude beyond the established planes are cut down and an ideal plane is established on the study casts.
5. The bite-rim may be transferred from the casts to the mouth and thus serve as a jig or guide for trimming down protruding cusp points.
6. Since the anterior teeth have been severely abraded, the wax is molded to establish a favorable incisal guidance, avoiding steep inclination.

Guidance Established in Mouth—As stated previously, condylar and incisal guidances having been established on the articulator, they must now be similiarly established in the mouth. In addition, esthetics should be considered to be sure the upper teeth will be of the necessary length and contour. Further observation should be made to ascertain provision for the average freeway space of 2½ to 3 millimeters.

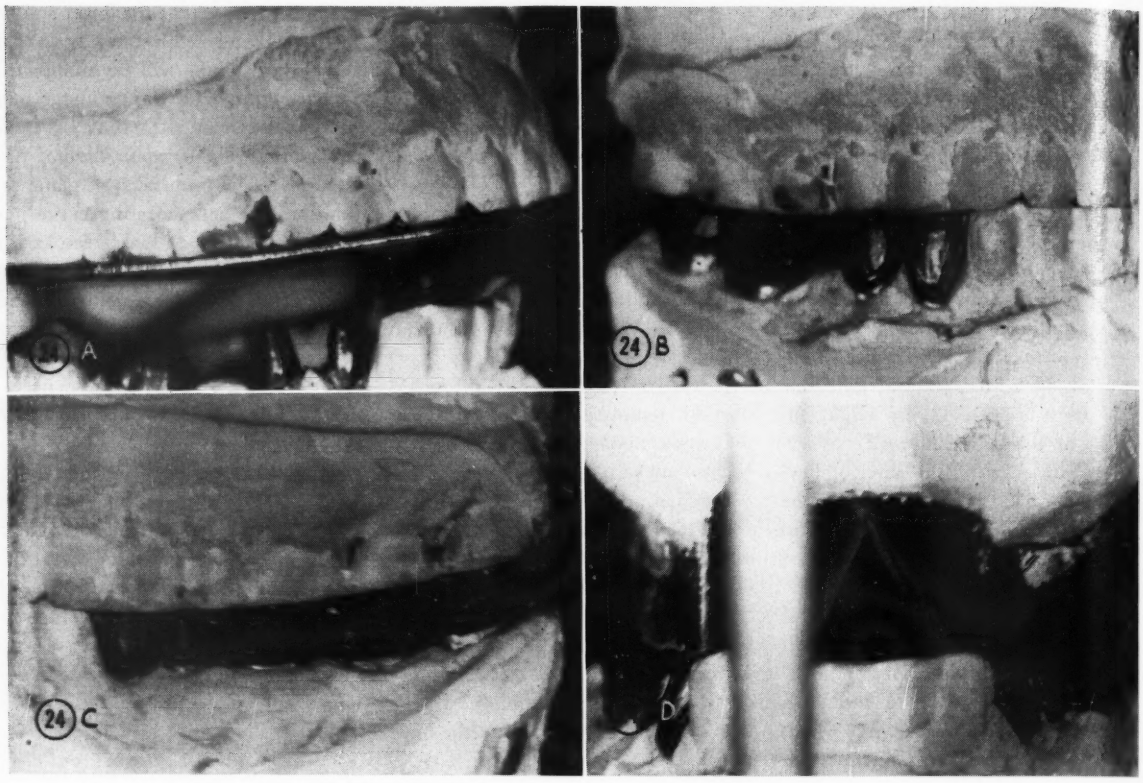
New Impressions May be Taken—1. If it was necessary to trim any of the teeth in the mouth, new accurate impressions must be taken and the casts remounted one at a time by means of established wax bites.

2. Cast occlusal onlay splints may be fabricated to maintain in the mouth the plane of occlusion established on the study casts.
3. Replace the upper, previously tested, bite-rim on the articulated upper model (Fig. 24A).
4. To the lubricated lower model add inlay wax to replace the lower bite-rim (Figs. 24B, and 24C).
5. The pattern for the lower splints will now be formed in the wax so that the occlusal plane will be established to harmonize with the condylar and incisal guidances.

Harmony Obtained in Lateral Excursions—The occlusal wax plane establishes the compensating curve but does not determine the degree of cusp inclination and cusp heights to maintain harmony with the condylar and incisal guidances in lateral excursions. The Seides method acceptably facilitates attainment of these necessary factors. The following procedure is completed:

1. Two thin strips of German silver (Fig. 24D) or similar metal about an inch wide are trimmed so that their lower edges are conformed to the curvature of the inlay wax occlusal plane just made. These will serve as blades to carve the wax so that cusp inclinations and heights may be obtained.
2. The blades are tacked to the inlay wax with sticky wax, on edge along a line representing the central groove of the lower posterior teeth. This sealed edge of the metal runners represents the relative position of the palatal cusp points in their relation to the lower central grooves.
3. The upper model is removed from the articulator and a new mounting plate replaces it. This is boxed with a strip of baseplate wax long enough to encompass the free edges of the metal runners.
4. The articulator having previously been set to the desired height is now inverted and a mix of plaster is poured into the wax boxing engaging the free ends of the metal strips.
5. After the plaster has been allowed to set, the articulator is opened, carrying the metal strips as part of the upper ring.
6. Moving the bow of the articulator from side to side will establish buccal and lingual cusp inclines. Moving the bow anteroposteriorly will check on the compensating curve.
7. If maximum contact is not made with the runners all along its path, the wax may be built up as necessary.
8. Inasmuch as the patient has provided the condylar guidance and the

[23]Kurth, L. E.: Mandibular Movement and Articular Occlusion, JADA **39**:37 (July) 1949.



24A. *Upper teeth conformed to 20° template. (Modification of Seides technique.)*

24B. *Crowns waxed to the curve established on the upper teeth. Right side.*

24C. *Crowns waxed to the curve established on the upper teeth. Left side.*

24D. *Metal runners mounted to meet lower waxes on a line representing central groove of lower posteriors.*

incisal guidance and occlusal plane have been established, the articulator has produced an orderly refined occlusal plane which should harmonize with these guidances.

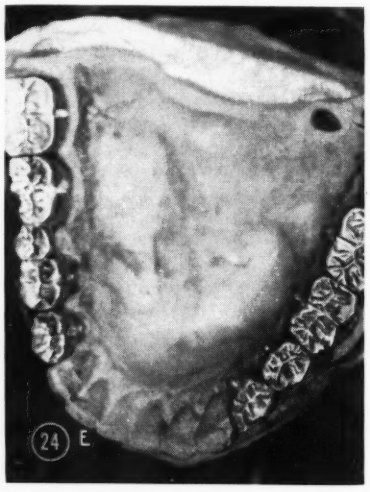
Refinements in Occlusal Anatomy Carved in the Waxes—1. Be sure to provide ample sluice ways in the patterns.

2. The waxes are invested and cast in scrap gold or equal parts of gold and silver.

3. After fitting and polishing they are replaced on the lower model (Fig. 24F).

4. Replace the upper model and wax splints to articulate with the lowers.

5. After casting, the upper splints are replaced and fitted. Check to see that there is balance in all mandibular movements.



24E. *Finished castings.*

6. The splints are tried in the mouth and spot ground if discrepancies exist.

7. A check on balance should also be made in the mouth in all mandibular excursions. After thorough polishing, the splints are cemented in position.

Trial Wear of Splints—The patient may wear these splints for as long a period as is considered necessary to establish the validity of the proposed reconstruction. When satisfactorily determined, permanent correction may proceed.

Selective Grinding—It is important to differentiate where to grind and where to build up occlusion once true centric relation is established. Judgment in using teeth of normal height as key teeth[26] is of great help in making this decision. Extruded abraded teeth, and intruded teeth are frequently encountered. It is obvious that in

[26]Millard, S.: Mouth Rehabilitation, N.Y. Dent. J. **22**:301 (Aug.—Sept.) 1952.

the first instance selective grinding is indicated. In the latter, building up must be the choice.

Additional Aid in Establishing Corrected Occlusal Plane—In some cases a 20° template (Fig. 25A) has been employed to help establish the corrected occlusal plane. Experience has shown that a majority of cases will easily adjust to this curve. The template is placed on the lower study model and if it seems that reasonable grinding of the teeth will permit general acceptance of this plane, interfering points are reduced and teeth below this level are built up to achieve as ideal a result as possible (Figs. 25B, 25C, and 25D).

Upper Teeth Must Conform—The upper teeth are trimmed or built up as the case may require, to conform to this desirable established plane.

Requisite Conditions Established—Having secured normal vertical dimension with centric occlusion coinciding with centric relation, the conditions requisite for a comfortable physiologic relation and function are established.

Summary of Procedure Outlined

The requirements described are for (1) shallow cusps, (2) reduced buccolingual diameters, (3) favorable crown root ratios, and (4) multiple splinting.

Aid in Biologic Function—According to Romine,[27] all types of restorations when built to correct periodontal specifications, perform a biologic function indispensable to the health of the periodontium. Restorations must therefore be built to two sets of specifications: biologic and mechanical.

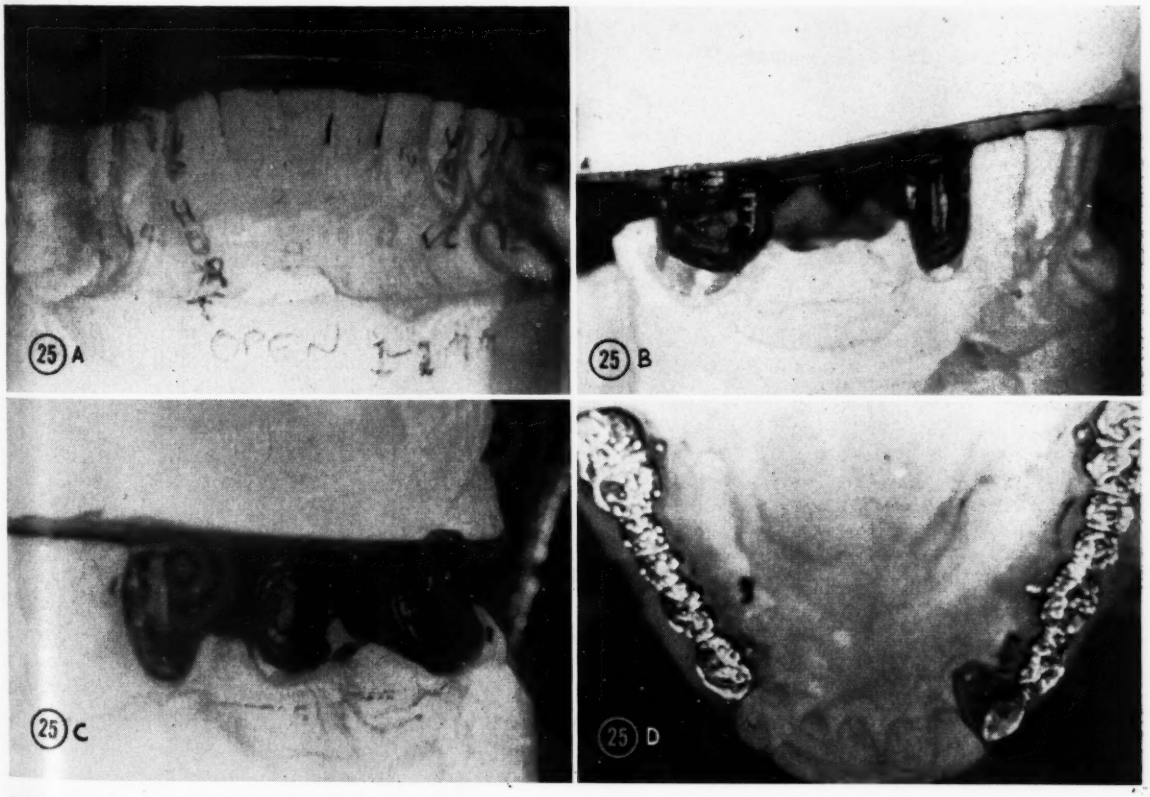
Determination of Mechanical and Biologic Aspects—The mechanical phase is determined by the preparations. The biologic is determined by the shape and form of the restorations; namely, contact, contour, occlusal form, buccolingual width and margins.

Factors Determining Amount of Protection—Management of the biologic and mechanical aspects determines the amount of protection afforded the supporting structures by the restorations. Failure to provide for the periodontal requirements will lead to periodontal disease.

Balance in Relation to Stress—Restorations should be constructed so that they are in harmony with the balance created in the remaining natural dentition. Failure to rebuild a balanced occlusion will inevitably result in compounding the forces of malocclusion and increase destruction from periodontal disease.

Required Factors in Treatment Planning—In the summary of treatment planning, success is based on completion of the following steps:

[27] Romine, E. R.: Relation of Operative and Prosthetic Dentistry to Periodontal Disease, JADA **44**:742 (June) 1952.



25A. *Conforming occlusal plane to 20° template.*

25B. *Crowns waxed to mounted template for upper contact. Right side.*

25C. *Crowns waxed to mounted template for upper contact. Left side.*

25D. *Completed castings.*

1. Elimination of irreclaimable teeth.

2. Securing and maintaining a periodontal optimum.

3. Establishment of a normal freeway space of approximately 2½ to 3 millimeters in restoration of lost vertical height.

4. Attaining a centric occlusion that will coincide with centric relation.

5. Eliminating displacement of the mandible.

6. Establishing correct incisal length and guidance.

7. Creation of an occlusal plane free from cuspal interference in function.

8. Providing natural and normal appearance of the patient's lips when in rest position.

(End of Installment Four)

200 *Central Park South.*

Cleft Lip and Palate

W. G. HOLDSWORTH, M.D.

CLEFT lip and palate occur with regularity in one birth in a thousand. The only recognized etiologic factor is heredity, though since one or two generations may be unaffected its application is often obscure . . . In 50 per cent of cases the cleft extends right through lip and palate, while in the remaining 50 percent clefts confined to the lip or palate are of approximately equal occurrence. There is an unequal distribution between the sexes, boys being the subject of cleft lip twice as often as girls, while the ratio is reversed in the palate. The left side of the lip is more often affected than the right, and single clefts of the lip are three times as common as the double clefts.

From *Journal American Medical Association* **156**:1579 (December 25) 1954.

Five-year Report on the Effect of Topical Applications of Sodium Fluoride on Dental Caries Experience

ARVID SYRRIST, and KJELL KARLSEN, Malmo, Sweden

Summary of Report

Data on the caries-inhibiting effect produced by topical applications of fluoride to the permanent teeth of a group of 91 children for a five-year period have been assembled. During the first two years one upper quadrant of teeth had been treated seven times with a 2 per cent sodium fluoride solution. At the last examination in 1952 the age of the patients was 17 years.

Analysis of Data

(1) During the two-year treatment period ending June 1949 the number of newly carious surfaces was 67 in fluoride-treated and 127 in untreated teeth, a difference of 47 per cent.

(2) In the following three years after cessation of treatment the number of newly carious surfaces was 247 in fluoride-treated and 268 in untreated teeth, a difference of 8 per cent.

(3) During the five-year period ending October 1952 the total number of newly carious surfaces was 314 in fluoride-treated and 395 in untreated teeth, a difference of 21 per cent.

(4) The total number of saved DF surfaces in this group of 91 children in which one quadrant was treated is 81, the mean savings per child being 0-9 DF surfaces.

(5) It is considered that data are lacking for a final assessment of the duration of the caries inhibition produced by fluoride applications and, hence, of its value as a routine public health measure.

From *British Dental Journal* **97**:6 (July 6) 1954.

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The Muscles of the MANDIBLE

R. J. LAST, M.B., B.S., F.R.C.S., London

DIGEST

It is usually extremely difficult, and in many cases impossible, actually to prove what is the action of a muscle. Although the writers of textbooks of anatomy do not hesitate to state categorically the action of every muscle they describe, they seldom quote any evidence. It does not follow that an eminent anatomist who is exact in his account of structure is equally correct in his interpretation of function.

This article is concerned with an attempt to assess the reasons for the presence and contours of certain muscles, and especially to understand the essential arrangements of the muscle groups involved in natural movements of the mandible, tongue, larynx, and face.

Action of a Muscle

The problem of the action of a muscle can be attacked from several directions, some of which are the following:

(1) Speculative reasoning and deduction, or "armchair anatomy." This is a dangerous method, for anatomists are notoriously poor at mechanics; but it remains the most commonly used approach.

(2) Feeling the muscle in contraction in the living. This has only a limited application, for many muscles are not palpable.

(3) Pulling on the muscle or its tendon in the dead. This is often impossible and it is usually unconvincing, since the background of tone in opponents is absent and synergists are out of action.

(4) The effects of paralysis. This may give a "negative print" of muscle action; but in a host of cases failure results from the fact that other muscles are employed to produce "trick" movements, and the paralysis is masked.

(5) Stimulation of a muscle or its motor nerve, exposed or not, with or without anesthesia. This is usually unconvincing, since the background of tone in opponents is absent or diminished under anesthesia, and synergists are likewise out of action.

(6) Action currents in the muscle during movement:

(a) by surface electrodes, a somewhat rough and ready method.

(b) by needle electrodes. This is possibly the most accurate method available, although spread of current from near-by muscles cannot always be ruled out. Moreover, action potentials recorded from a muscle during a given movement do not prove that the muscle is responsible as a prime mover for that movement. The muscle may be contracting synergically.

(7) Comparative studies. An assessment of the form and function of a similar muscle or group of muscles in a comprehensive series of other vertebrates will often, though not always, throw light on the action in man.

Fundamentals Commonly Accepted—If, for example, it can be shown that a certain movement causes the attached ends of a muscle to be pulled farther apart, for the muscle to be elongated, that particular movement cannot possibly be the action of that particular muscle. Or, if a movement approximates the attached ends of a muscle it is reasonable to assume that the action of the muscle *may be* to produce that movement, if not as the prime mover, at least to take part as an assistant in the movement.

Plan of Argument—The following simple premises are the basis of the reasoning:

(1) The skull is movable on the spine in all positions of the latter.

(2) The mandible is movable on the skull in all positions of the latter.

(3) The floor of the mouth is movable on the mandible in all positions of the latter.

(4) *There is a separate set of muscles provided for each of these three movements*, and confusion has arisen from failure to place certain muscles in their correct functional group.

Movements of the Skull

The skull rests on the top of the spine like a ball on a flagpole. Unsupported it would fall forward, for its center of gravity lies anterior to the occipital condyles. Guy ropes stabilize and, when required, move it. They are the extensor muscles at the back of the neck, opposed by the flexors, which are the prevertebral muscles, and the sternomastoids. The fact that the flagpole is a flexible, segmented structure does not invalidate the statement.

A set of balanced extensor and flexor muscles stabilizes and moves the cervical spine independently of movements of the skull. It should be noted that muscles moving the skull will also of necessity cause secondarily a bending of the cervical spine unless such effects are neutralized by the opposing spinal muscles.

Mistaken Assumption—The orthodontist, Brodie,[1] is mistaken in his assumption that the muscles of mastication play no part in head movements or in the maintenance of head posture. Brodie correctly extends the human head with the post-vertebral neck muscles, but he incorrectly opposes these anti-gravity extensor muscles with a chain of muscles consisting of (1) the muscles of mastication (temporalis and masseter, which join the mandible to the skull), (2) the suprahyoid muscles that join the hyoid to the mandible (Brodie lumps them all together as though they all share a common action), and (3) the infrahyoid muscles that join the hyoid bone to the pectoral girdle, and he talks of the reciprocal inhibition of the infrahyoid muscles that accompanies contraction of the temporal muscle and elevation of the hyoid bone in swallowing.

Three Links in Chain—In his chain of skull-flexing muscles, Brodie has three links. If one of these muscle links is inhibited (according to the principle of reciprocal inhibition) surely the whole chain of muscles is correspondingly weakened. It would seem that the head should jerk back willy-nilly into extension every time we swallow.

Pectoral Girdle Not Fixed—Not content with ignoring the flexor muscles of the skull, Brodie stops short in attaching his own chain of imaginary skull-flexing muscles to the pectoral girdle. For the pectoral girdle is not fixed. It moves up and down with respiration, with upper limb movements, with abdominal contractions.

Premise Untenable—How can Brodie say that the infrahyoid muscles relax to allow the hyoid bone to ascend in swallowing? It is just as logical to argue that pectineus relaxes for the same purpose. Let the believers in the Brodie conjecture look to the pectinei and adductores longi while they are assessing the causes of malocclusion in their patients, and ponder whether this reductio ad absurdum does not indicate that Brodie's premises are quite untenable.

Rotators or Abductors—Extension and flexion of head and of cervical spine having been accounted for by the paired semispinales capitis and sternomastoids, with other weaker muscles, it only remains to say that acting singly these muscles are rotators or abductors of the spine and head.

Little Interest to the Orthodontist—These movements of the skull and of the neck are of little interest to the orthodontist and are menioned only to exclude them from the arguments about the mandible and the floor of the mouth, each of which is entirely independent of head position and movement and is served by a separate musculature.

Movements of the Mandible

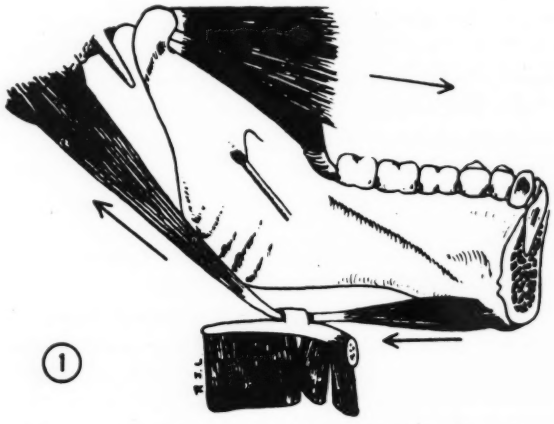
The resting position of the mandible is one of slight separation of the teeth, by a few millimeters at the incisors. From the resting position or from occlusion the hinge movement of opening is accompanied by a forward movement of the mandibular head from the glenoid fossa down the slope toward the articular eminence of the zygoma.

Simultaneous Movements—Two simultaneous movements take place in the mandibular joint, (1) the hinge movement occurs at the lower, (2) the gliding movement at the upper compartment of the joint.

Muscles Responsible—The lateral pterygoid is rightly allotted the function of producing the forward movement, but a considerable collection of muscles are considered responsible for the hinge movement. Those usually named are the mylohyoid, geniohyoid, and the anterior belly of the digastric, to which are often added the infrahyoid muscles, gravity, and even the innocent platysma.

A Simple Movement—Consideration of the movements in the mandibular joint, and the muscles responsible for each movement, complicates what is, in fact, a simple movement; namely, a rotation of the mandible about an axis that passes nearly through the mandibular foramina.

Muscles that Open the Mouth—Picturing the mandible as a ship's steering wheel, it is evident that its uppermost spoke is pulled forward by contraction of the lateral pterygoid. The analogy of the steering wheel fails in one important respect; namely, that there is no fixed mechanical axle around which the jaw rotates. Pulling forward the uppermost spoke of a steering wheel produces rotation about its own axle; pulling forward the mandibular condyle produces no rotation, but only protrusion of the mandible as a whole. The mandibular "wheel" is stabilized, not upon an axle, but by its uppermost spoke, the condyle, being held by the ligaments of the mandibular joint. It is evident that to produce rotation it is necessary to pull in an opposite direction on a "spoke" more or less diametrically



1. ***The mandible is opened by the rotational pull of the lateral pterygoid and the digastric muscles. The digastric slides freely across the hyoid bone.***

[1]Brodie, A. G.: Am. J. Orthodont. **36**:831, 1950.

opposite. There is a powerful muscle that is admirably placed to perform this movement; namely, the digastric muscle (Fig. 1).

The Digastric Muscle—As the mandible is moved from the closed to the fully open position the chin not only falls lower but moves backward. The common statement that the anterior belly of the digastric is responsible seems to the writer to be naive. What would happen if the posterior belly remained relaxed? The anterior belly would simply pull forward and elongate the relaxed fibers of the posterior belly, and no mandibular movement could possibly result. Both bellies of the digastric must obviously contract with equal force (if not with equal shortening) if any movement is to result. The fact that the two bellies have different nerve supplies has no bearing on this, since the motor nuclei of the pons are connected by longitudinal fibers, as are all the motor nuclei of the brain-stem and spinal cord.

To imagine that the primary reason for the existence of the human digastric is to elevate the hyoid bone is to lose sight of two facts: (1) the muscle is badly placed for the mechanics of such a movement, and (2) the hyoid has its own proper elevators.

The Mylohyoid Muscle—The floor of the mouth is a muscular diaphragm which forms a highly mobile base for support of the tongue. This is the function of the mylohyoid, and in ordinary action *the muscle has nothing whatever to do with opening of the mouth.*

The Geniohyoid Muscle—The essential difference between the anterior belly of the digastric (Fig. 1) and the geniohyoid muscle (Fig. 2) is that the tendon of the digastric runs freely through a pulley; the powerful digastric muscle depresses the chin by pulling from the mastoid process, without any effect on the anteroposterior positions of the hyoid bone. The digastric asks only that the hyoid bone be held down, and there is a strong group of infrahyoid muscles to do that. Geniohyoid can only depress the chin if the hyoid bone is held back, and there is only a relatively feeble stylohyoid muscle to do that.

Gravity—It is wrong to suggest that gravity is of any real importance in the picture of mandibular movements. Several reasons support this view:

(1) Opening the mouth is just as easy when lying upside down. Watch a newborn child crying while held upside down by its legs to drain mucus or liquor amnii from its throat.

(2) A nursling lying with its face pressed sideways against a soft breast, its own light mandible supported in a firm mass of muscle and fat, could not open its mouth as briskly and quickly and widely as it does when sucking were gravity a relevant factor.

(3) The normal rapid chewing movements of the adult at his repast are too swift and of too great an amplitude to be due to gravity.

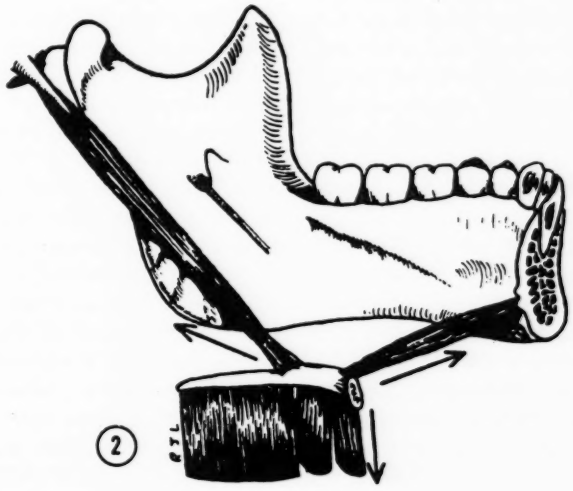
(4) Watch anyone speaking. The mandibular opening is, again, much too rapid and too well controlled to be due to gravity.

(5) Allow the muscles of mastication to relax completely and the jaw to droop. The mouth is only half open; to take a good bite from an apple a conscious mouth-opening effort has to be made.

(6) What separates the teeth when they are stuck together by chewing gum, toffee, or like substance? Gravity?

Platysma—While other muscles, such as risorius and the depressors of the lower lip open the lips, the platysma is an accessory opening of the jaw. It can be called an accessory muscle of mouth opening in the same way as the sternomastoid, for example, can be on occasion an accessory muscle of respiration, but neither action has a place in the picture of *normal* movements.

Accessory Muscles of Mandibular Depression—All over the body it is seen that each movement is served by its own set of muscles, but in many situations it happens that additional muscles, not normally concerned in the movement, can be called upon to act as accessory muscles. This is well illustrated in the case of the respiratory excursions of the ribs. Normal tranquil respiration is carried out by the intercostals and diaphragm alone; forced breathing is performed by many other muscles not normally concerned at all in the respiratory act. In the same way, under *abnormal conditions*, accessory muscles can be used to assist the lateral pterygoids and digastrics to rotate the jaw into the open position; such muscles are the geniohyoid, those few fibers of mylohyoid which are attached to the



2. ***The anteroposterior position of the hyoid bone (that is, the length of the floor of the mouth) is determined by the stylohyoid and geniohyoid muscles, both of which are fixed to the hyoid bone.***

hyoid bone together with the depressors of the hyoid bone, and even the platysma.

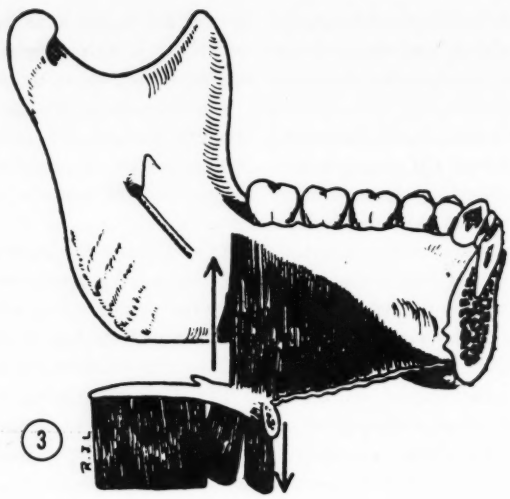
Closing the Mouth—Retraction of the mandibular condyle is brought about by the posterior fibers of the temporalis and the mandible is rotated into occlusion by the rest of temporalis, the masseter, and the medial pterygoid.

Lateral Movements of the Mandible—The muscle balance which is responsible for stabilizing and moving the mandible is a mechanism that can be adjusted to allow asymmetry in the amount of forward movement of the condyles. Such asymmetry allows the mandible to be slewed to one or other side. The pterygoids, both lateral and medial, are essentially the muscles responsible for these lateral mandibular movements, the lateral pterygoid in opening and the medial pterygoid in closing the jaw. The grinding motion of the molars is a combination of lateral with anteroposterior movement of the mandible; this is produced by the pterygoid muscles of right and left sides contracting alternately while upward pressure of the mandible is maintained by temporals and masseters.

Movements of the Floor of the Mouth

The floor of the mouth, the mylohyoid, is a muscular "diaphragm" whose resemblance to the pelvic floor is striking. In each case a flat sheet of muscle slopes downward from a curved bone into a mid-line raphe. When the muscle is relaxed, the gutter between the two sides is at its deepest; contraction of the muscle raises the floor and makes the gutter more shallow.

Mobility Provided—The mid-line raphe of the oral floor is attached posteriorly to the hyoid bone and is thus extremely mobile in relation to the mandible. The hyoid bone can be moved forward and backward, upward and downward, and rotated around a transverse axis; that is, the floor of the mouth can be lengthened or shortened anteroposteriorly, and can also be elevated or depressed with relation to the mandible.



3. ***The vertical level of the hyoid bone is determined by the mylohyoid and infrahyoid muscles.***

Range of Tongue Movements Increased—The mobility of the floor of the mouth greatly increases the range of excursion of all the tongue movements. The position of the hyoid bone along the anteroposterior range is determined by the relative lengths of the geniohyoid and stylohyoid muscles (Fig. 2).

Secondary Elevating Effect—Each of these muscles has a secondary elevating effect similar to that of the digastric. This is counterbalanced by the depressing effect of the infrahyoid strap muscles. Sternohyoid and omohyoid act directly as depressors, while sternothyroid acts directly via the thyrohyoid muscle.

The vertical position of the hyoid bone is determined by the upward pull of the posterior fibers of the mylohyoid muscle, balanced by the opposing infrahyoid muscles (Fig. 3).

Principle Elevator—The floor of the mouth is its own elevator; the mylohyoid is a sling lying under the tongue, and when it contracts it lifts the tongue upward. Tongue movements are essential to normal speech and mastication, but they accompany also a simple uncomplicated opening of the jaw. It is almost impossible to keep the tongue in the same position relative to the mandible while the mouth is opened; the tongue is protruded, retracted, heaped up or flattened according to the purpose required, and depending largely on whether nose or mouth breathing occurs.

Contracting Mylohyoid does not Produce the Mandibular Movement—The hyoid bone is moved by its own muscles so that it takes up its appropriate position in all positions of the mandible; the muscles that so move it are not the primary movers of the mandible. Depression of the mandible is usually accompanied by contraction of the mylohyoid, but the contracting mylohyoid does not *produce* the mandibular movement. In the same way, depression of the mandible is usually accompanied by opening of the lips, but it would be absurd to argue that the dilator muscles that open the lips produce mandibular movement, even though they contract simultaneously.

Hyoid Bone Movable in all Directions—In practice it is demonstrated that hyoid movement in respect to the mandible accompanies the slightest movement of the tongue. In speaking and chewing the hyoid is never still. Its greatest excursion takes place during swallowing. Here the floor of the mouth is elevated to its highest, reducing the volume of the mouth to

the minimum, so that the tongue must go back, propelling the bolus into a pharnyx drawn up and open, waiting to receive it. The posterior part of the tongue is not only pushed back passively by the elevation of the floor of the mouth, but is pulled back actively by the stylo-glossus muscle.

Role of the Tongue in Swallowing—When the mylohyoid contracts, the tongue is not pushed upward as an inert mass. By the active contraction of its own musculature the tongue adapts its shape to the requirements of the action being performed.

Effects of Inert Tongue—When the tongue is inert, speech, mastication, and swallowing are all adversely affected. This is seen in idiots, or in cases of bulbar palsy where the hypoglossal nucleus is involved. The assumption that the tongue is relatively passive during the mylohyoid stage of swallowing seems to the writer to be a fallacy in the present-day assessment of the effects of swallowing and tongue movements in the production of malocclusion.

The Ideal Swallow—During continuous drinking of liquid from a vessel, swallowing is performed with teeth and lips apart, yet no liquid is squirted back into the vessel. This action of the tongue, in which complete control of the liquid bolus is obtained without assistance from the teeth, is surely the ideal swallow. It is the usual swallow in many native races, particularly in those who masticate with the lips parted.

Movements of the Larynx

It is of great importance to the protection of the human larnyx that its inlet be simultaneously updrawn below the protective shelf of the posteriorly bulging tongue as the bolus passes into the pharynx. This explains the attachment of the larynx to the floor of the mouth, via the hyoid bone and the thyrohyoid muscle; as the floor of the mouth ascends, the larynx ascends with it. In addition, the larynx has its own proper elevators, the stylo-pharyngeus, salpingo-pharyngeus, and palato-pharyngeus each of which has most of its fibers inserted into the thyroid cartilage and only a few into the side wall of the pharynx.

Movements of the Face

The muscles supplied by the facial nerve, called the "muscles of facial expression," produce those small alterations of facial contour to which by experience we are highly sensitive, but the muscles are not there primarily to produce facial expressions. In man the sphincter and radial dilators are best developed around the mouth.

A fact of especial importance to the orthodontist is that the facial musculature is applied over a convex skeleton of bone. Contraction of the muscles causes pressure upon the underlying bones and teeth. The lips press backward upon incisors and cuspids, the modiolus and the buccinator press inward upon bicuspids and molars. These pressures are counteracted by that of the floor of the mouth and the tongue within the teeth, and during mastication the bolus is moved and returned between the occlusal surfaces of the teeth by reciprocal contraction of the facial muscles on the one hand and the floor of the mouth and the tongue on the other. The buccinator and tongue are important muscles of mastication.

Possible Cause of Malocclusion—There seems little doubt that inequality between the opposing forces of mastication can result in shift of the teeth in one direction or another. Once malocclusion exists for any reason in the young it will tend to persist or increase by reason of muscle pressures, for a sloping tooth is in unstable equilibrium and separation of the teeth allows greater protrusion of cheek or tongue between them.

Gross Malocclusion from Faulty Habits—In certain Abyssinian races studied closely by the author, a gross malocclusion of the type Class II Division I (Angle) was noted. So protruberant are the upper incisors in these people that it is only by conscious effort that the lips are held in apposition, and in the relaxed position the upper lip rides up to expose the central incisors, thus giving a false impression of smiling. Chewing is accomplished with the lips open, and *swallowing is usually performed with an open mouth.*

Deformity Acquired—The masticatory habit in this race is present throughout life, from babyhood to old age. The forward movement of the tongue is unopposed by the lips; conversely, the modiolus lies with unwonted pressure against the bicuspids to prevent the vestibular contents from escaping through the open lips. The incisors are pressed forward by the tongue, the bicuspids and molars are pressed inward by the cheeks. This acquired dental characteristic is not transmitted. The young babies have normal faces with well-arched gums in good contact, but the dental deformity appears in early childhood and progresses into adult life.

Malocclusion in Europeans—In Europeans a potent cause of malocclusion may lie in similar faults in chewing rather than in swallowing. Swallowing is a momentary event, chewing a much more prolonged affair, and the forces applied by the tongue and cheeks are much greater in chewing than in swallowing. In the uninhibited Abyssinian, who swallows with teeth and lips widely open, there is no forward thrust of the tongue in swallowing, but only in chewing. In the well-trained European, if the lips are kept together, malocclusion, however caused, encourages an "infantile" type of swallow, for the tongue and lips now meet between the parted teeth. To argue that a persisting infantile type of swallow is the original cause of the malocclusion would seem to be highly speculative and unconvincing, confusing effect with cause.

Adapted from *Proceedings of the Royal Society of Medicine,* Section of Odontology, **47**:17-24 (July) 1954.

SUGAR CONTROL

in Children's Diets

JAMES J. MACMILLAN, D.D.S., Carbondale, Pennsylvania

DIGEST

This article discusses the relative effectiveness of two methods used in advising parents concerning dietary caries-preventive measures for children. The first, and least effective method, permits the ingestion of sugar in moderation; the second method, and most effective, prohibits sugar as contained in candy and soft drinks, at all times.

Dietary Preventive Measures

Method One—In this method for control of dental caries it was suggested that children be fed an optimum diet with plenty of milk, unrefined foods, meat, eggs, fresh fruit, and vegetables. Sugar, pastries, candy, and soft drinks were to be taken in moderation. At various times, as they were recommended to the dental profession as preventives of tooth decay, cod liver oil, calcium di-phosphate wafers, bone meal, and thyroid extract were advised.

Method Two—It is suggested that when the proper age arrives children should eat the regular family meals, desserts in the proper place, but not to be eaten until the preceding food has been eaten. *At no times are the children to be allowed any candy or soft drink.*

Application of Preventive Measures

The advice contained in these two methods of approach to the problem of dental caries in children has been given innumerable times over a period of thirty-five years. The advice was given for the most part under the conditions permitted by the average busy general dental practice. Abruptness of presentation was avoided, but briefness and impact upon the listener were always sought. Method One was used for approximately the first twenty-five years and Method Two for the next ten years.

Results Studied—The caries rate and dental condition of over one hundred patients in ten families through four generations were studied. By ages and generations for purposes of observation these persons are classified in the following four groups:

(a) 3 to 10 years
(b) 25 to 45 years
(c) 45 to 65 years
(d) 65 years and over

Four Generations Represented—Group (d) is entered for hereditary purposes only. Group (c) is composed of the parents of members of Group (b), and (b) members are the parents of (a).

Because a change from Method One to Method Two was made after twenty-five years, some of the members of Group (b) were advised as to Method One, others as to Method Two.

No Caries-free Deciduous Teeth in Method One—Despite careful presentation to parents in the (c) group of Method One, no mouths with caries-free deciduous teeth appeared in Group (b). The permanent teeth of the (b) group required in most cases considerable restorative dentistry. Proximal caries was extensive in many members of this group.

A and B Group Conditions Similar in Method One—Children in the (a) group whose parents had been advised according to Method One and who practiced it had teeth in a condition similar to those of the (b) group at the same age.

Deciduous Teeth Caries Free in Method Two—Children in the (a) group whose parents had been advised according to Method Two and who practiced it presented mouths in which the deciduous teeth were caries free. One child at the age of nine has had a slight fissure cavity in one of her first permanent molars restored; the dentine had not been penetrated. This is the only caries which has appeared to date in this group. The number of children in this caries-free group is at the present time seven, from five families. The next oldest child is seven and the youngest is three.

Hereditary Influences Absent—No evidence was found in this group study that heredity plays any part in the physical condition of teeth from one generation to another.

Discussion of Relative Merits of Methods

Method One was conscientiously advocated for the first twenty-five years of practice, chiefly because it was the author's conception, gained from study of the writing and teaching of the time, of the proper approach to the subject. Method One was discontinued because the results of the method were extremely discouraging. The desired results; namely, caries-free teeth, did not appear. Questioning of parents as to sugar consumption proved unsatisfactory. Even where caries was classed as

rampant, parents always maintained that the child had not had "much" candy or "much" soft drink.

Method One Discontinued—Because satisfactory results did not occur at any time in a twenty-five year period, a decision was made *to change the advice from the nondefinite prescription of sugar in moderation to the specific prescription of absolutely prohibiting candy and soft drink at any time.* A change in the whole situation was observed when this was done.

Change Effected in Advisory Stage—The parents were being told explicitly what could be included in the diet and what must be excluded. The indefiniteness which had characterized Method One as to the amount of sugar consumption was no longer present.

Affirmative Approach—The question was no longer one of moderation, it was now a direct question: "Has your child had *any* candy or *any* soft drink?"

Parents' Responsibility—The impact on the listener of this handling of the problem was found to be impressive and positive. The duty to the child of sugar control had been placed directly where it belonged, with the parents.

General Diet Unchanged—Method Two does not stress the type of food the child should have: the advice was only that the child should eat the food the family eats. Desserts were not to be eaten until the main dishes were eaten. In the first interview, unrefined foods, meat, eggs, fruits, proteins, milk, and other desirable items were not mentioned to avoid overcomplicating the advice, and confusing the listener.

Taste for Desserts Lessened—An important change in the eating habits of the caries-free children is that they do not care particularly for desserts. It is more common for them to refuse dessert than it is to eat it. When dessert is eaten, ice cream is preferred to cake and pastry.

Cultivation of Food Habits

Observation over a long period of time has raised considerable doubt as to whether a child's first taste of candy and soft drink is pleasing. The author is inclined to the belief that these tastes are not pleasing at first.

Taste for Sweets Acquired—It is true that consumption of sweets on a national scale is enormous and increasing, but this does not refute the fact that by giving sweets to young children parents may possibly be creating in them a taste which is at first not pleasing.

Taste not Developed in Method Two—It was found that in the caries-free children the desire for soft drink and candy was not a problem because the taste for these items had not been created. It was observed that neighbors and relatives were more likely to tempt children with sweets than were the parents. Once the parents had taken a firm stand and made their wishes known, outside interference was eliminated.

Voluntary Discrimination Developed—As the children grow older they become candy and soft drink resistant. They reach a stage where apparently they like to attract attention by refusing candy and soft drink. Attracting attention, at parties for example, and dental school examinations, seems to appeal to their vanity, and most children seem pleased if they can be the center of attraction for some accomplishment, in this case certainly a meritorious one.

Disadvantages in Method One—Parents following Method One are forced to listen to continual teasing by their children. A taste for candy and soft drink has been created and it is a taste not easily satisfied. Consequently, no matter how much of these items are allowed, to the child it never seems enough.

Advantages Demonstrated in Method Two—In a child of eight, guided according to the advice in Method One, the allowance of sugar and soft drink is a certain quantity each week, but this does not conform to the child's idea of the proper allotment. Coaxing for more is a problem in this instance. Another child, in the same family, aged five, has had no candy or soft drink and does not ask for any, a situation so pleasing to the mother that she says she intends to exclude sweets from this child's diet as long as possible. She states that the dietary habits of the child reared in Method Two are much more satisfactory than those of the child in Method One.

Future Results Unpredictable

What the final outcome will be for these children, at present caries free, is not known. When parental control is removed will these children voluntarily form eating habits which will cause caries, or will the lack of desire for sweets which is apparent now remain with them indefinitely? Time alone will answer these questions.

Conclusions

1. Advice regarding candy and soft drink in the dietary regime of a child should specifically recommend that they be excluded.

2. Advising moderate use of both of these items places the responsibility for the amounts to be allowed upon the parents who have no way of knowing how much is moderate and how much is excessive.

3. The moderate use of candy and soft drink in a child's diet is not dangerous because of the sugar content per se. The greatest danger lies in the development of a taste for sweets which at times becomes uncontrollable.

4. Small children have no control in the choice of the foods offered them. It is the duty of the parents to see that their children are properly fed and it is the duty of the dental, medical, and allied professions to see that parents are properly advised in dietary matters.

First National Bank Building.

FLUORIDATION

and PERIODONTAL DISEASE

HAROLD K. BOX, D.D.S., Ph.D., Toronto, Canada

DIGEST

The author of this article, an eminent authority on periodontal disease, states his reason for believing in the possibility of a relationship between fluoridated water supplies and gingival and periodontal disease. The author states furthermore his considered opinion that artificial fluoridation of water supplies on a wholesale basis should not be advocated or adopted until fully adequate evidence shows that there are no harmful sequelae from a gingival or periodontal standpoint.

Statement

In the November, 1954 issue of DENTAL DIGEST there appeared a short article adapted from *Prevention*, August, 1953. This article mentioned that I had found severe gingivitis and significant periodontal disease during studies of persons using naturally fluoridated water for several decades.

No Survey Undertaken

I would like to state that I have never made a survey of gingival and periodontal diseases in any area where the water was naturally fluoridated. Furthermore, I have made no observations along these lines in practice on persons who have used naturally fluoridated water for several decades, and I have written or published nothing on this subject. So far as I know, no survey of periodontal diseases has ever been carried out in any area of naturally fluoridated water in Canada.

Investigation Advocated

For some years I have advocated the conduction of surveys of gingival and periodontal conditions in such areas, and in control areas where the water is not fluoridated.

Preferred Classification — In relation to future surveys of periodontal diseases, I would prefer the use of my own classification which comprises Simplex, Necrotic, and Complex Periodontitis.

Thorough Methods Advised — Obviously, the measures adopted for obtaining the findings should be especially thorough, and, in my opinion, should include a radiographic examination in every case.

Basis for Belief in Possibility of Relationship—My reasons for believing that a possibility of a relationship between fluoridated water supplies and gingival and periodontal diseases exists, are, in part, based on the following findings from various sources:

1. The known presence of alga-like formations and fungoid organisms in dental plaques and developing calculus.

2. The experimentally proved stimulating effect of minute quantities of sodium fluoride on the growth of algae and fungi.

3. The presence of a relatively high amount of calcium fluoride in dental calculus, as shown by an analysis (1.55 per cent).

4. The high incidence, as shown by survey, of a severe gingivitis in the children of Stratford, Ontario (79.2 per cent, 6-14 years). The water of Stratford has been naturally fluoridated for many years (1.6 ppm).

5. The evidence which tends to show an increased incidence of gingivitis in areas where the fluoride concentration was more than 4 parts per million.

A Serious Problem—The problem of the relationship of fluorine to the tooth and periodontal structures is the responsibility of the dental profession. Surely no one will deny that periodontal disease is at least as serious a problem as dental caries in the overall picture of human welfare.

Conclusion

At the present time the available findings on gingival and periodontal diseases, as revealed by survey, are totally inadequate. It is my considered opinion that the artificial fluoridation of water supplies, on a wholesale basis, should not be advocated or adopted until fully sufficient findings show that there are no harmful sequelae from a gingival or periodontal standpoint.

University of Toronto
Faculty of Dentistry.

The EDITOR'S Page

THE DENTAL profession is composed predominantly of men. The death rate among men has risen in the past 35 years as compared to the death rate for women. This fact should interest all men, including dentists.

There is something increasingly lethal operating within the male population. It may have to do with our eating, drinking, smoking, and working habits. It may be something fundamentally weaker in the biologic entity of men. We do not know the cause or causes of this biologic inferiority.

No less a pillar of traditional medicine than the *Journal of the American Medical Association* has in a recent editorial called this situation to the attention of the physicians of the country.[1] The *Journal* has asked "Why is the death rate increasing faster for men than for women?"

These facts are brought forth in the editorial: "The death rate for white men between 45 and 54 years of age in 1920, for example, was 10 per cent higher than for women in the same age group, but in 1950 it was 78 per cent higher. . . . The death rate for men in this age group between 1921 to 1926 and 1942 to 1947 for cardiovascular renal diseases *increased* 35 per cent and in women *decreased* 27 per cent. A similar trend was noted regarding deaths from peptic ulcer. These diseases are commonly associated with excessive nervous tension. The death rate from lung cancer (always greater in men than women), although representing only a small fraction of the total death rate, has increased much faster for men than for women in the last quarter of a century. . . . The time has come to recognize the need for greater effort in discovering the reason for this sex difference in mortality and to take steps to prevent the needless curtailing of the lives of men in the most productive years."

In the same issue of the *Journal of the American Medical Association* the truth of these statements is revealed upon examination of the causes of death of the 53 physicians listed in the obituary columns. Of the 53 notices the cause of death is listed in 40 cases. Among the 40, this breakdown is significant: cardiovascular diseases (coronary occlusion, cerebral hemorrhage, arteriosclerosis, hypertension, heart failure), 24 cases; cancer, 7 cases; pneumonia, 2 cases; postsurgical death, 1; accident, 1; hepatitis, 1; intestinal obstruction, 1; sarcoma, 1; emphysema, 1; pulmonary edema, 1.

In this list the overwhelming death rate from the degenerative diseases is significant compared to the deaths from bacterial diseases. The diseases of bacterial causation are low in the list. The diseases that represent, for want of a more descriptive term, biochemical imbalances, are at the ignominious top of the list. It is a safe presumption that the mortality tables among dentists would be found to be similar to those among physicians.

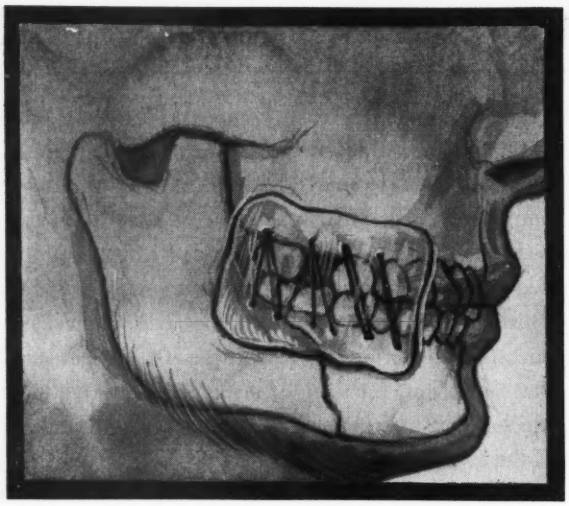
The *Journal*, following its commendable conservative policy, speaks with words of caution in postulating the possible reasons for the increasing death rate of men and the decreasing death rate for women:

"The proportion of women employed outside the home has steadily increased. This fact would not support a contention that occupation might account for the difference in death rates, but, on the other hand, a difference in the attitude of women toward their employment as compared to that of men may be a factor. A tendency for women to escape the consequences of worry by being more vocal or more tearful than men may be a factor. Another factor may be a change in the conditions of employment for men. More and more men are doing jobs by machinery that formerly required great muscular effort. This increase in more or less sedentary work may adversely affect the body economy. The relatively higher death rates from venereal disease, alcoholism, homicide, and accidents in men may be due to their greater aggressiveness and lack of caution."

These explanations appear to be too superficial. More likely the difference in the mortality rates between the sexes will be found to be in the differences in the chemistry of the endocrine secretions of men and women. Andricity or maleness seems to be associated with early degeneration and death; gynicity or femaleness with a longer survival.

Every man, and certainly everyone who practices one of the healing professions, should contemplate this increasing incidence of the lethal diseases among the male population.

[1] Editorials and Comments, JAMA **157**:41 (Jan. 1) 1955.



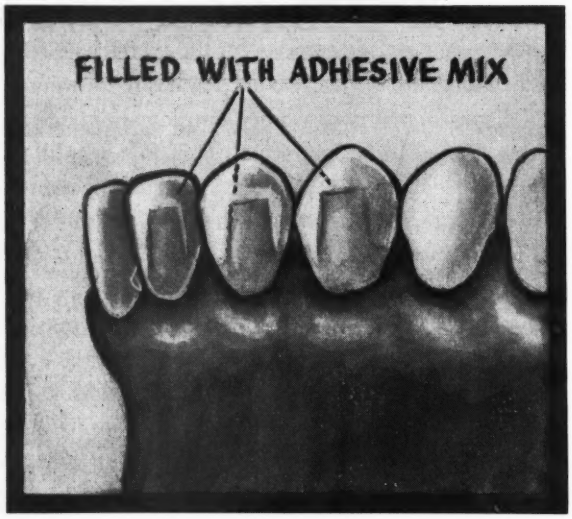
1

Clinical and Laborato

Acrylic Cheek Protector

Stephen T. McGrath, D.M.D., Kingston, New York

1. To prevent irritation of the cheek from the intermaxillary wires that are used in fracture fixation, make a protector of quick-curing acrylic. A modeling compound impression is made of the teeth as wired in occlusion. A stone model is poured and upon this the acrylic is molded.

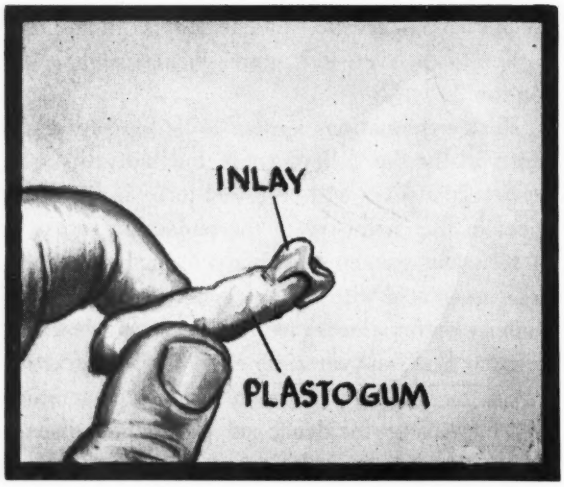


2

Holding Jacket Crowns in Position to Make Adjustments

Sidney Horowitz, D.D.S., New York

2. A mix is made of one of the denture adhesive powders and water. This mix is put inside the jacket crown to hold it in position while the contact fit and the bite are adjusted.



3

A Holder for Polishing Castings

Edward J. Berens, D.D.S., Hammond, Indiana

3. Plastogum or any quick setting plaster is placed inside the inlay or crown to form a handle to be used when polishing the casting.

READERS *are Urged to Collect $10.00*

For every practical clinical or laboratory suggestion that is usable, DENTAL DIGEST will pay $10.00 on publication.

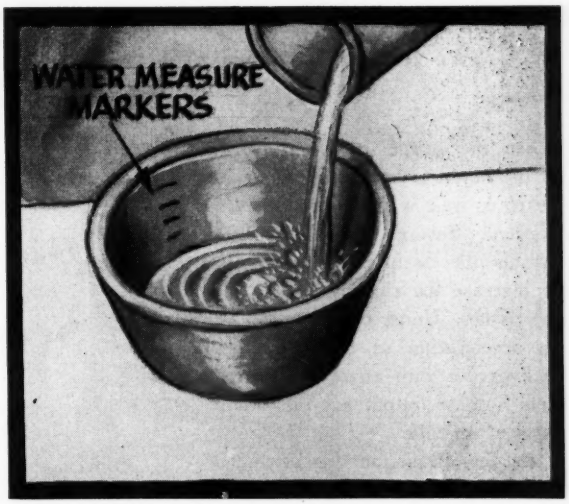
You do not have to write an article. Furnish us with rough drawings or sketches, from which we will make suitable illustrations; write a brief description of the

SUGGESTIONS . . .

Uniform Plaster and Investment Mixes

Milton Goldstein, D.D.S., Newark, New Jersey

4. Water measure marks are made inside the rubber plaster bowl using paint or nail polish. These marks are placed to show the exact amount of water that is to be used with the proper proportion of plaster or investment powder.

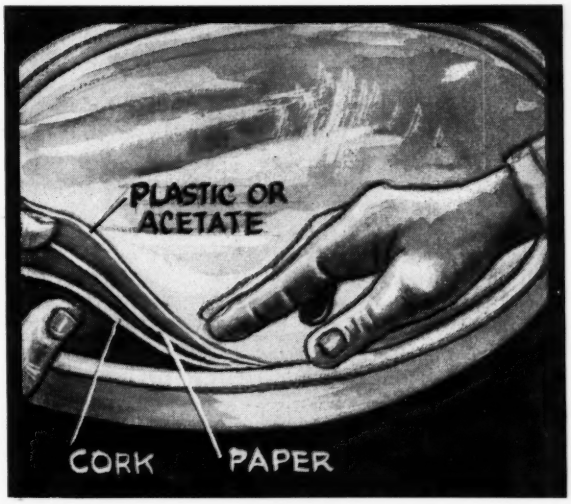


4

An Improved Bracket Cover

Ben E. Pleshette, D.D.S., New York

5. Cut a piece of 1/16-inch cork to fit the bracket. Over this place a regular bracket cover. Use a plastic to cover the paper. These three layers of material reduce noises that develop while placing the instruments on the operating bracket. The plastic cover can be wiped off with soap and water.

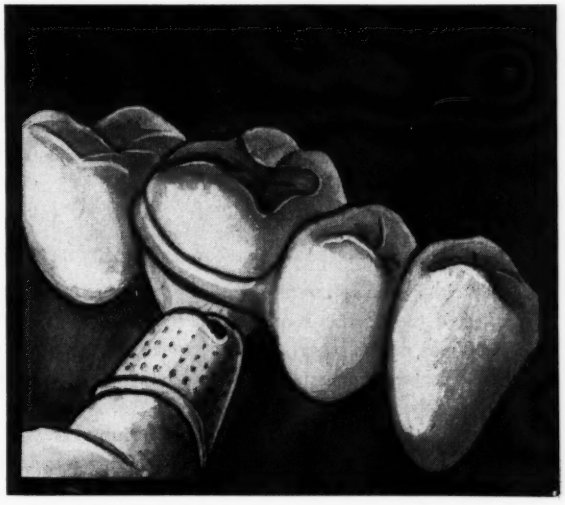


5

A Method to Remove a Partial Denture

T. A. Del Papa, Galveston, Texas

6. A semilunar cut is made near the top of a sewing thimble. The projecting part is contoured to the shape of the clasp. When this thimble is used to remove a clasp the fingernails are protected from injury.

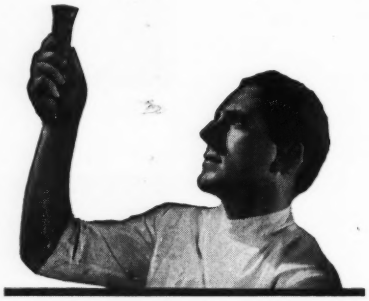


6

technique involved; and jot down the advantages of the technique. This shouldn't take ten minutes of your time. Turn to page 186 for a convenient form to use.

Send your ideas to Clinical and Laboratory Suggestions Editor, DENTAL DIGEST, 708 Church Street, Evanston, Illinois.

MEDICINE and the Biologic Sciences



The Heart in Anemia

When the oxygen-carrying capacity of the blood is impaired, the healthy heart, as well as the diseased heart is affected. Several physiologic mechanisms operate in the anemic person to increase the supply of oxygen to the tissues. Under conditions of rest, an acceleration of blood flow and tachycardia with an increase in minute volume output are the first effects of anemia.

As compensation develops, the tachycardia and increased velocity flow are largely replaced by selective shunting of blood and the removal of a larger percentage of oxygen in the tissue capillaries from each gram of circulating hemoglobin. The later mechanisms are best illustrated in cases of chronic parasitic anemia.

In conditions of physical stress, the cardiac output increases. In cases of compensation as a result of accelerated pulse rate and cardiac filling and an augmented stroke volume with no increase in peripheral resistance. Tachycardia and accelerated velocity flow may not be physiologically adapted to prolonged strain, but rather are mechanisms to meet acute bodily stresses such as exercise, fever, hypermetabolism, and acute anemia.

Unequivocal myocardial hypertrophy is uncommon in an anemic patient unless the patient has been physically active during most of the period of the anemic state or unless some intrinsic cardiac disease or hypertension coexists. Dyspnea from effort, due to an encroachment on the respiratory reserve, is the most frequent symptom.

A patient with chronic anemia may have more intense pallor than the hemoglobin level indicates. The state of the vascular bed apparently varies according to the need for oxygen in different areas of the body.

Myocardial anoxia resulting from anemia can be prevented only by shunting of blood to the heart, since 90 per cent or more of the oxygen is abstracted from the coronary blood during passage through the myocardium.

Electrocardiographic studies in acute and chronic anemia indicate minor changes in about 20 per cent of the subjects. However, the changes are not specific for anemia. High output failure is often the result of the effects of anemia on the already diseased or overworked heart. The relief of anemia may be a deciding factor between recovery or intractable failure.

Complete relief of angina pectoris by appropriate treatment of the anemia is observed. Effort angina, however, probably occurs in patients with anemia only when the coronary arteries are abnormal.

The physical signs and symptoms in many anemic patients strongly indicate heart failure of the congestive type. Congestive failure, however, does not result from anemia in patients whose hearts are otherwise healthy. The coexistence of intrinsic cardiovascular disease is almost certain, if true congestive failure occurs. However, when the anemia is successfully treated, the prognosis of congestive heart failure in the anemic patient is good.

Porter, William B., and James, G. Watson III: The Heart in Anemia, Circulation **8**:111-116 *(August)* 1953.

Sense of Smell in Diagnosis

The sense of smell is a valuable diagnostic aid. The olfactory sense is much more acute than that of taste. The practical obstacles in the diagnostic use of smell stem from the problems of classification and the subjective describing of odors.

The physiology of smell is still inadequately understood. The sense of smell can be rapidly exhausted for one odor and yet remain acute for other odors. The odors of several substances may combine to form an entirely new odor, the single components no longer being identified.

Pleasant odors may be referred to as fragrances, and disagreeable or offensive ones as fetors or stinks. Odors are best described by comparisons with well-known fragrances or fetors.

Odors are produced by elements such as bromine, and by every class of compound. Odor and chemical formula are not related; widely different formulas sometimes have similar odors.

The intensity of an odor usually decreases with dilution. The quality of an odor may also change with dilution, so that a substance with a disagreeable odor when concentrated may have a delightful aroma when diluted. Indole has a fecal odor when concentrated, but is fragrant in high dilution.

The odor of sweat comes from a combination of factors. Fresh sweat of normal persons apparently is odorless. The odor arises from decomposition caused by bacteria on the skin. The malodor of sweat may be increased by decomposition of secretum from sebaceous glands and, in the genital region, by the addition of secreta from the glandulae odoriferae, special sebaceous glands.

Urine may have a special odor

after consumption of particular substances. After eating asparagus the urine has a typical odor of methylmercaptan. Ingestion of turpentine oil gives a scent of violets to the urine. Fresh urine has an aromatic smell, resembling bouillon.

The fruit-like odor of acetone on the breath of a diabetic patient establishes the diagnosis of acidosis. The breath of uremia patients has a distinctly urinous smell. Fetor hepaticus refers to the sweetish, mousy, new-mown hay smell of patients with severe hepatic failure and usually indicates a poor prognosis.

Fetor oris can be caused by a multitude of pathologic conditions including: (1) gingivitis, (2) stomatitis, (3) pyorrhea, (4) scurvy, (5) inflammation from mercury poisoning, (6) oral cancer, (7) diseases of the teeth, (8) chronic tonsillitis, (9) syphilitic or tuberculous ulceration, (10) putrid bronchitis, (11) bronchiectasis, (12) gangrene of the lung, (13) gastritis, (14) ileus, (18) decomposition of food in an esophageal diverticulum, (16) gastrointestinal hemorrhage, (17) neoplasms, and (18) pyloric obstruction.

Engle, Charles: Diagnosis by the Sense of Smell, M. J. Australia **2**:254-258 *(September)* 1953.

Penicillin Reactions

When first introduced the antibiotics were thought to be relatively nontoxic. This is not true, however. Skin reactions are observed with all the five most widely used antibiotics. These include: (1) penicillin, (2) streptomycin, (3) chloramphenicol, (4) aureomycin, and (5) terramycin.

The dermatologic manifestations of penicillin toxicity are of three general types: (1) urticaria and angioneurotic edema—the serum sickness type of reaction, (2) vascular phytid reactions, and (3) exfoliative dermatitis.

The most common reaction is the serum sickness type, occurring in as many as 4 per cent of those receiving parenteral penicillin. Which effects are caused by the penicillin and which by the oily and waxy depots or impurities in manufacture have not yet been determined. Urticaria may be seen with all types of penicillin. The interval between the administration of the drug and the onset of urticaria is usually about thirteen days. The interval as well as the duration of symptoms varies widely.

Vesicular phytid reactions usually appear promptly after start of penicillin dosage and affect mainly the palms, soles, groins and intertriginous areas.

Exfoliative dermatitis may vary from slight transient reactions to severe, even fatal, forms.

Oral penicillin has an extremely low incidence of side reactions.

Primary treatment for any form of penicillin sensitivity is stopping the drug. In the urticarial-angioneurotic edema types, antihistamines should be used in large and prolonged doses. After start of such treatment, urticaria usually clears in about six weeks. Adrenalin is given in emergencies. Severe cases respond to ACTH and cortisone.

If the lesions of the phytid or exfoliative dermatitis types are not severe, discontinuance of the antibiotic and application of bland local therapy usually will suffice. In more severe cases ACTH or cortisone may be required.

Unless no other treatment will do, penicillin should not be given to anyone who has had previous reactions. The drug should never be administered to prove a doubtful diagnosis of sensitivity.

If penicillin dosage is essential, desensitivation should be attempted. Another approach is the use of penicillin O which is somewhat less antigenic than penicillin G and just as effective. Many instances of cross reactions are known, however, and if the patient is extremely sensitive, caution is essential.

Crissey, John T., and Caccamise, Charles W.: Antibiotic Drug Eruptions, New York J. Med. **53**:2085-2088 *(September)* 1953.

Use of Heat in Rheumatic Diseases

The objectives of physical medicine in rheumatic disease therapy are many. They include: (1) relief of pain and spasm, (2) improvement of circulatory efficiency, (3) maintenance of muscle strength, endurance, and coordination, (4) prevention or correction of joint range of limitation, (5) prevention or minimizing of deformity, (6) increase in functional capacity in terms of self-care and essential daily activities, and (7) physical, psychosocial, educational, and vocational rehabilitation of the severely handicapped patient.

A wide variety of physical agents and techniques are available. In general these may be grouped under the headings: (1) thermotherapy, (2) mechanotherapy, (3) therapeutic exercise, and (4) rehabilitation.

Thermotherapy is one of the most valuable aids available. Heating agents are indicated for the relief of pain and muscle spasm associated with some rheumatic diseases. In addition, they produce vasodilatation and increase in arterial blood flow to a given part. These agents provide either dry or moist heat.

Heat application may also be either superficial or deep. For most rheumatic processes superficial heat will suffice. Moist rather than dry forms of heat are better tolerated by the patient. Superficial techniques are advantageous in that they do not require elaborate equipment and can be performed by the patient or some responsible member of his family. This keeps the cost of chronic illness down and also provides treatment, when needed, free of the difficulties of schedules in the office or outpatient department of the hospital.

Superficial moist heat may be obtained by the use of hot packs, paraffin, or warm tub. Superficial dry heat in the form of luminous or infrared rays may also be of value. Electric field or electromagnetic induction techniques of short-wave diathermy or, more recently, microwave diathermy are office or hospital pro-

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cedures and are useful in cases in which deep heat is required.

Contrast baths are useful in combating some of the vascular disability of the rheumatoid extremity. One technique which the patient can learn to do at home involves a nineteen-minute regime, starting and ending with immersion of the hands or feet in water at a temperature of 105° Fahrenheit for four minutes. These four-minute periods in hot water are alternated with one-minute immersions in water at 65° Fahrenheit, thus four minutes hot, one minute cold, four hot, one cold, four hot, one cold, and four hot. This can be done once or twice daily as recommended by the physician.

Frequently the problem arises of using heat on an extremity exhibiting occlusive vascular disease. This is particularly true in the elderly arthritic patient with arteriosclerotic peripheral vascular disease. In such a situation the reflex effects of heating may be employed by applying heat proximal to the extremity; that is, diathermy to the pelvis or low back and insulation of the leg with turkish toweling.

Dinken, Harold: Physical Medicine in Treatment Rehabilitation of Rheumatic Disease **8**:643-648 (*December*) 1953.

Thirst as a Symptom

There are some conditions in which intracellular dehydration is important. In many of these conditions, thirst is a valuable symptom.

When considered as a sensation, thirst is localized in the mouth. Objective evidence is found in oral dryness and the decreased salivary flow which causes the dryness. The salivary flow can be measured with fair accuracy by blocking the nose with a clip to ensure mouth breathing and collecting all saliva in a graduated centrifuge tube for five minutes.

The decreased salivary flow correlates as well with the degree of dehydration in cases of simple dehydration. An exception to this occurs when patients have severe sodium depletion, as in acute food poisoning with severe diarrhea, when little or no thirst is felt.

The symptom of thirst cannot be used as a yardstick in fluid replacement therapy. A dehydrated man in the desert will drink back only 75 per cent of the deficit.

Polydipsia in diabetic insipidus is apparently secondary to the polyuria and represents the thirst of simple dehydration. Other endocrine dysfunctions, such as hyperparathyroidism, probably cause polydipsia through the same mechanism.

Myasthenia gravis is representative of diseases in which thirst is related to a specific defect in secretion. Salivary flow is reduced in untreated cases and is restored by administration of prostigmine. Thirst may be associated with psychiatric and emotional disturbances. Differentiation from true polydipsia is usually simple.

The cardiac patient who is accumulating fluid is frequently thirsty.

The thirst may warn of impending edema before fluid retention is noticeable. The cause of thirst in cardiac failure is unknown.

Thirst may precede the fall in blood pressure when patients are going into shock from hemorrhage. Blood donors do not ordinarily experience thirst unless shock is impending. Thirst, therefore, is a valuable warning in a bleeding patient.

Holmes, Joseph H., and Montgomery, A. V.: Thirst as a Symptom, Amer. J. M. Sciences **225**:281-286 (*September*) 1953.

Uric Acid and Gout

In its early stages gout is characterized by recurrent acute attacks of arthritis that respond specifically to treatment with colchicine. In its later stages it is characterized by progressive deposition of sodium urate in cartilage and around joints in association with chronic arthritic changes. The salient feature of the disease is hyperuricemia, a condition shared by siblings and close relatives of the patient.

Uric acid metabolism is a factor in the etiology of gout. The property that makes uric acid something to be reckoned with is its insolubility, both as the free acid and as the sodium salt. The stable solubility of urate in serum is of the order of 6.5 milligrams per 100 cubic centimeters. Above that concentration it may still remain dissolved but as an unstable supersaturated solution subject to sudden precipitation. The factors that influence this precipitation are for the most part unknown. In the internal body fluids, the precipitate formed is sodium urate; in acid urine, it is uric acid.

Hyperuricemia is essential to gout. However, additional factors are responsible for the acute attack. The following factors are characteristic of gout: (1) the suddenness of onset, (2) the predilection for the metatarsophalangeal joint of the great toe, (3) the exquisite tenderness and pain,

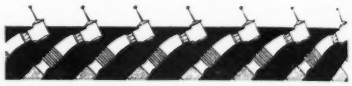
(4) the specific rapid response to colchicine, and (5) the slower spontaneous complete remission without medication.

There is evidence that a temporary adrenocortical deficiency has something to do with the acute gouty episode. The commonest precipitating factors of an acute attack are (1) trauma, (2) surgical operation, (3) infection, (4) allergic reactions, (5) exposure to heat or cold, (6) psychic stress, and (7) foreign protein therapy. These are all factors producing stress that are associated with a sudden increase in secretion of adrenocortical hormone, followed by a decrease to a subnormal level. Excessive excretion of sodium has frequently been seen at the time of the attack.

Management of gout to be successful must provide not only alleviation of the acute attack but also a mechanism for a continuous negative balance of uric acid until the miscible pool has been restored to normal size. Colchicine in doses of 0.5 or 0.6 milligrams every two to four hours usually produces a remission in 48 hours. The drug has no effect on urate metabolism or excretion. It offers no benefit in long-term management. Only by preventing the accumulation of urate and by ridding the body of the stored urate can true improvement be accomplished.

Hoffman, William S.: Metabolism of Uric Acid and its Relation to Gout, JAMA **154**:213-217 (*January* 16) 1954.

Contra-Angles



Insomnia Has No Terrors

A friend of mine is preoccupied with his sleep habits. He has the feeling that a sound and uninterrupted sleep of eight hours is necessary to health and well-being. If he does not get this quota, he fears that his vital processes are in danger. He believes that his sleep should be as sound as that of a child.

The mystery of sleep has never been penetrated. The physiology of sleep is not well understood. There are a number of theories that have been advanced to explain this death-like state but none is considered to be the complete answer.

During sleep the blood pressure is reduced, the pulse rate is slowed, the metabolic tempo is diminished, respiration is depressed. All this suggests a diminution of vital forces. Whether this inhibition comes from the cerebral cortex or from an older part of the brain, the hypothalamus, is not known. The stimulus that sets in motion the chain of reactions that produce sleep has never been described. Some physiologists believe cerebral ischemia is a prelude to sleep. Others think that a chemical soporific is produced in the body that

has a selective affinity for a sleep center that is located some place in the nervous system. This is all quite vague to me as apparently it is to neural physiologists.

In any case, we should not fear that fitful sleep, or even insomnia, will endanger our health. The worst thing about insomnia is the worry that it creates and the worry increases the insomnia. Worry mobilizes the body as does any other anxiety and thus produces tension. It is a vicious circle.

If lack of sleep comes from the inability to get to bed or from pain, the results of sleep loss may be real and significant, but for the person who spends seven to eight hours comfortably relaxed in bed without worry or tension, the actual lack of sleep is of little importance. If a person exposes himself to the conditions for sleep the "wisdom of the body" will dictate how much sleep he will actually need.

Carrying the cares and problems of the days to come to bed is one of the grave hazards to refreshing sleep. Most every dentist at some time has "practiced dentistry" during the night except that he had nothing to show for his "labors" in the morning. Everybody must try to cultivate the habit of pulling the switch on business and other worries as soon as he goes to bed. That is not always easy to do. Emotions or thoughts that stimulate the brain centers are not easy to eject the moment one goes to bed.

The discipline that we should *try* to follow is that of making our minds a blank and concentrating on faraway pleasant things. The urgent, the immediate, the practical problems of living should be put aside and our thoughts should be spread over leisurely, relaxing, nonpractical subjects. We should try to recall the sensations and the emotions that give us the most pleasurable experiences: The white puff of clouds in June, water lapping against a rowboat, moonlight upon the country snow, the sweet new-mown hay. These are examples of restful thoughts associated with memories from nature. Some people have a personality structure that gives them pleasure from other kinds of associations. Sensations and values are entirely personal experiences and each person must choose for himself the thoughts that he considers most restful.

The fetish of a complete unconsciousness of eight hours out of every twenty-four has led to the wide sale of sleep-inducing preparations. Some of these drugs are infinitely more dangerous if used habitually than the insomnia that they are to correct. An occasional therapeutic dose of a barbiturate to relax unusual tension should do no harm. To become dependent and addicted to a drug is a dangerous habit.

This preoccupation for sleep is demonstrated in our current society by the advertising claims that are being made for soporifics that can be had "without a doctor's prescription." This suggests that every drugstore is being converted into a depot

where drugs powerful enough to affect specialized nerve centers may be had for the asking. Maybe there are no direct or accumulative effects from these preparations. Even if there are no ill results, the habit of depending on a drug to aid a physiologic function is an evil practice.

No one can be annoyed with the emphasis on a good mattress and well-designed springs as wooers of sleep. Some of the superlatives that are used to describe these pieces of furniture are, however, a bit excessive. They can hardly be called orthopedic devices to correct every ache and pain that moves up and down the spinal cord and its environs. Nor do they represent the experience of floating on a cumulus cloud. A clear and honest statement would be that good bed equipment gives the comfort that induces sleep.

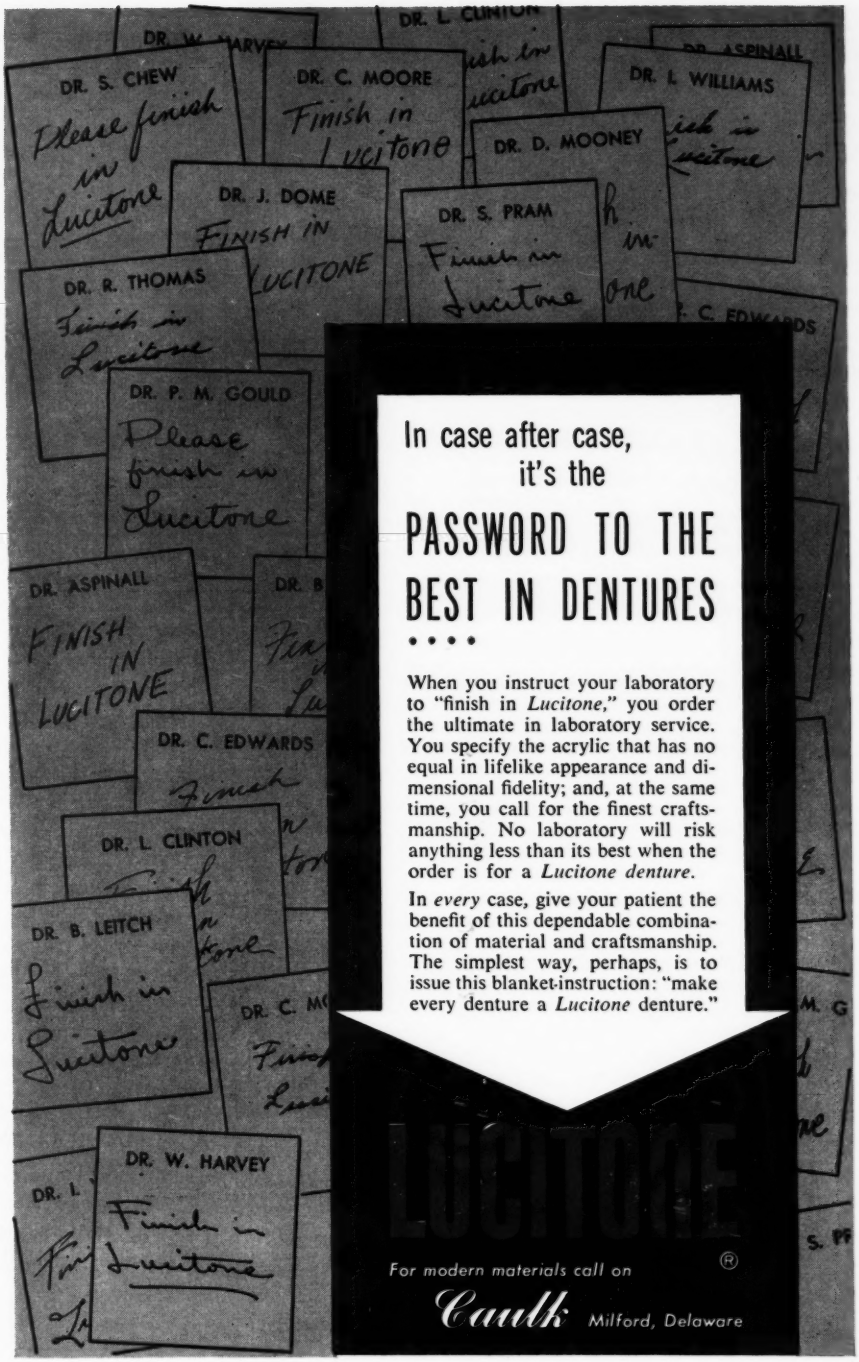
Sagging and snarling bedsprings and a tumorous or sodden mattress should be abolished. A good bed is important for good sleep. Placing your carcass in that bed for eight hours is a wise practice. After one is there, let the physiologic processes determine how much sleep is required. We will not be far wrong if we let the "wisdom of the body" decide how much sleep is necessary. Worry about insomnia never gained a minute of sleep, but worry has lost us many hours of sleep.

You Can Kill Yourself in Bed

Hand in hand with the matter of sleep when one is well is the subject of bed rest when one is ill. The present tendency in both medicine and surgery is toward early ambulation. Enforced bed rest has been the prelude to disaster for many patients, for man seems to do best when he keeps his muscles in tone by movement.

On this subject the *Heart Bulletin* (September-October, 1954) speaks:

"Man is thought to be the only vertebrate that lies on its back when ill. Man is also one of the few vertebrates that normally stand in an erect position. It might be expected because of these extremes that the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(*See pages* 174 *and* 175)

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circulatory changes that follow a movement from the erect to the prone position would be more pronounced in man than in most other animals. Among the immediate effects of lying down are a slowing of the pulse, a slight drop in blood pressure, and a general decrease in the work requirements placed upon the body, and thus in the cardiac output. There is also a tendency toward hemodilution and an increase in the total blood volume, due to a shift of fluids from the tissues to the blood vessels. Within a week following confinement to bed there appears a disturbance in the mechanism by which adequate circulation is maintained in the erect position, with a consequent tendency to faint on arising from bed. This is due largely to degenerating muscular and venous tone in the legs, leading to postural hypotension and tachycardia.

"Beyond this, the vital capacity of the lungs is also reduced in the prone position. Muscle strength and girth decrease through disuse, with increased nitrogen excretion. Calcium is reused from bone, with a resultant tendency toward osteoporosis or nephrolithiasis. Resultant changes in clinical chemistry may contribute toward such common later characteristics of prolonged inactivation as an increased clotting tendency and thrombophlebitis."

The renewing tonic of rest is important for the maintenance of health. More rest is needed for the body that has become depleted of resources by illness. After the deficiency has been corrected and the negative balance has been repaired, the body should rise from bed as quickly as possible and reenter the world of movement and motion. Those deep-seated feeling tones, those priceless endowments of natural instinct, give us the message to tell us when it is safe to leave our bed.

—E. J. R.

The Mechanism of Thrombosis

Study in Development

Etiologic and pathogenic studies of thrombosis have shown that several factors are involved in its development:

(1) Abnormalities of the inner surface of the vessel which can be caused by anoxia or infection and might exist even in the absence of any histologically demonstrable lesion.

(2) A localized or general slowing of the blood stream.

(3) Different modifications of the blood such as an increased platelet count; a lowered plasmatic albumin: globulin ratio; an increased fibrinogen level; a hastened sedimentation rate of erythrocytes.

Improvement of Circulation

Before anticoagulants were introduced as preventive and curative treatments of thrombosis, prophylactic measures had been successfully used for combating thrombo-embolic disease. Great care was taken not to damage the vessels, to avoid infections, but above all, to improve blood circulation, especially in the lower extremities.

Methods Used—Among the means employed to avert blood stasis were (1) foot and leg exercises in bed (sometimes with appropriate apparatuses); (2) deep breathing exercises; (3) avoidance of restriction to respiration or of postures slowing the venous circulation; (4) early ambulation of surgical and obstetrical cases; and (5) circulatory and respiratory analeptics.

The results of the measures used to improve circulation were extremely favorable. They were frequently omitted, however, in the prophylaxis of thrombosis after the usefulness of anticoagulants in thrombo-embolic disease had been published.

Conclusion

Thrombosis needs the synergistic collaboration of several disorders for its occurrence. The best preventive and curative treatment of this disease must therefore be a synergistic one. This includes, in accordance with Burgi's law: (1) hygienic conditions for the patients, (2) perfect surgical techniques, (3) measures for improving blood circulation, and (4) the use of anticoagulants.

Adapted from *Roskam, Jacques: Arrest of Bleeding, Springfield, Illinois, Charles C Thomas,* 1954, *pp.* 61-62.

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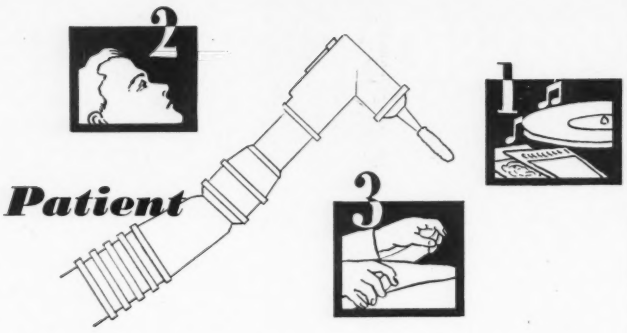

Relaxation

Doctor Irving H. Barnett believes that "it is within the capacity of every practicing dentist, whether a specialist or general practitioner, to relax his patients so that they will accept the routine dental procedures and operations more easily." He describes three techniques which induce relaxation.

★ ★ ★

"A Dentist Leads Fight Against MS" — multiple sclerosis. Doctor Harry Cimring tells of Doctor Joseph J. Karpeles' work with and in behalf of multiple sclerotics. Doctor Karpeles is one of the founders of the Southern California chapter of the National Multiple Sclerosis Society, and member of its national board of directors. The sclerotic patient presents special problems to dentists and is usually very grateful when these problems are solved with understanding. Dr. Cimring explains the special needs of the sclerotic patient.

★ ★ ★

If you are planning on building a new office—or even renovating your old one, you may get some helpful ideas from Doctor George W. Matthews' new Oral Surgery Clinic. Eight photographs and a floor plan show the interesting details of this well-planned building.

★ ★ ★

Doctor L. D. Weeks joins the discussion of OASI by reporting that 85% of the dentists in Iowa voted in favor of coverage by Old Age Survivors Insurance when polled in January. He suggests that "If the majority of the dentists in our district meetings this spring vote in favor of OASI, then each district should elect delegates and a trustee who are known to be favorable to our inclusion in OASI. If any holdover delegate or trustee refuses to comply, he should be replaced."

★ ★ ★

"Suggestions for Guidance of Dentists Establishing Identity of Disaster Victims" is an excellent summarization of general rules for the dentist who finds himself at the scene of a plane or train accident or a fire. Identification of victims is accelerated by following the procedure outlined in this article by Doctor Ted P. Bradley and Doctor L. W. Miller.

★ ★ ★

Dentists in Tucson, Arizona, where a Community Chest Drive was held recently, were proud to be the first of four campaign groups to make 200 per cent of their quota. These dentists and their chairman, Doctor Charles H. Tweed are saluted in the department, "Picture of the Month."

The Virginia State Dental Meeting will be held on shipboard this month when *The Queen of Bermuda* sails from Norfolk on a week's cruise to Havana and Nassau. The ship will also pick up dentists in New York, and any members of the dental profession who would like to attend this "Convention of a Lifetime" are invited to join the Virginia group at either point of embarkation.

★ ★ ★

Don't forget the regular departments: So You Know Something About Dentistry!, Dear Oral Hygiene, Technique of the Month, Dentists in the News—and all of the rest.

Advertising Index